US Army Corps
Of Engineers
St. Paul District

MISSISSIPPI RIVER 9-FOOT CHANNEL PROJECT

CHANNEL MANAGEMENT PROGRAM

DEFINITE PROJECT REPORT/ ENVIRONMENTAL ASSESSMENT

POOL 5

CHANNEL MANAGEMENT STUDY

Pool 5
Upper Mississippi River
Buffalo County, Wisconsin and
Wabasha and Winona Counties, Minnesota

July 1999

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14. ABSTRACT
The purpose of this study was to evaluate channel management in pool 5 on the Mississi River, from Lock and Dam 5 at river mile 738.2 upstream to Lock and Dam no. 4 at river mile 752.8. Study efforts focused on measures to reduce the frequency of dredgi problem areas, preventive maintenance, and using dredged material to construct islands habitat purposes. No significant navigation problems were identified aside from chan shoaling in the mid-pool reach. There has been significant decline in fish and wildli habitat in the lower portion of pool 5 due primarily to loss of islands, sand sediment in backwater habitats, decline in aquatic vegetation and a reduction in bathymetric diversity. The primary restoration measure is the construction of five small islands lower Belvidere Slough area using channel maintenance dredged material. Wing dam not will also improve fish habitat.

POOL 5 CHANNEL MANAGEMENT STUDY

EXECUTIVE SUMMARY

The Pool 5 Channel Management Study is part of the St. Paul District Corps of Engineers' overall channel management program for the 9-Foot Navigation Channel Project on the Upper Mississippi River. An important facet of the program is the use of channel control structures to reduce or control dredging requirements, to provide a safer navigation channel, and to reduce or eliminate adverse effects on river resources. The study area for the Pool 5 Channel Management Study was navigation pool 5, from Lock and Dam 5 at river mile 738.2 upstream to Lock and Dam 4 at river mile 752.8.

Channel maintenance, navigation, fish and wildlife, and recreation problems were identified for the study area and planning goals and objectives were formulated. The primary channel maintenance problem in pool 5 is the high frequency, high quantity dredging requirements in the middle reaches of the pool (river miles 742 to 750). No significant navigation problems were identified aside from channel shoaling in the mid-pool reach.

Fish and wildlife habitat concerns identified for the upper one-half of the pool were relatively site-specific, focusing on side channel changes, backwater sedimentation, and bank erosion. There have been significant habitat changes in the lower portion of pool 5 since the pool's creation in 1936. Habitat concerns in this reach of the pool are more broad based due to an overall decline in habitat diversity and quality. The decline is primarily due to the loss of islands, sand sedimentation in backwater habitats, a decline in aquatic vegetation, and a reduction in bathymetric diversity.

Weaver Bottoms is a large backwater area on the Minnesota side of pool 5 that has been the subject of intensive study for over a decade. Because of the ongoing independent study efforts for this area, Weaver Bottoms was not studied as part of the Pool 5 Channel Management Study. The same is true for Spring Lake, located on the Wisconsin side of lower pool 5, which is the subject of an independent habitat restoration project under the Upper Mississippi River System-Environmental Management Program.

No specific recreation problems related to channel control structures were identified, though it was recognized that maintaining existing beaches along the navigation channel was important to meeting recreational needs in pool 5. Access for recreational craft in Belvidere Slough and adjacent is a concern due to sand sedimentation, as is access the Half Moon Landing, located above Weaver Bottoms.

It was recognized early in the study that achieving substantial reductions in overall dredging quantities in pool 5 via structural measures was unlikely. Therefore, study efforts focused on measures to reduce the frequency of dredging in problem areas; on preventive maintenance

measures to keep channel maintenance or navigation problems from occurring, or at least from getting worse; and on using channel maintenance dredged material to construct islands for habitat purposes.

Measures evaluated to address specific channel maintenance/navigation concerns included closing dam reconstruction and bank stabilization at the head of West Newton Chute (river mile 750.0); wing dam restoration and bank stabilization at the head of Belvidere Slough (river mile 748.0); side channel stabilization and wing dam modifications at Roebuck's Run (river mile 746.6); and wing dam modifications at Minneiska Bend (river miles 742-743).

There was insufficient justification for closing dam reconstruction at the head of West Newton Chute. The recommended plan in this location is stabilizing the head of Island 42 to minimize future loss of main channel flow to West Newton Chute. At the head of Belvidere Slough, the recommended plan is to fortify an existing wing dam to prevent migration of the navigation channel. It was determined that bank stabilization was not necessary at this location.

In the Roebuck's Run area, the recommendation is to stabilize Roebuck's Run with a rock sill and bank protection. The intent is to prevent further aggravation of an outdraft problem and existing channel maintenance problems. In addition, two wing dams would be modified to narrow the channel with the intent of decreasing the frequency of marginal channel conditions and dredging frequencies in this location.

No action is proposed at Minneiska Bend, pending further evaluation of the structural modification of the Weaver Bottoms outlet that took place in 1997.

Environmental measures evaluated in the upper reaches of pool 5 included stabilization of the head of Island 40; modifying the outlet to Wiggle Waggle Slough; modifying the inlet to the Mosiman's Slough area; and alleviation of a sedimentation problem at the inlet to Willowcat Slough. Stabilizing the head of Island 40 proved too costly to be justified. No action was deemed the best course of action at the Wiggle Waggle Slough out, with continued monitoring of the area by State natural resource agencies.

No action was deemed necessary at Mosiman's Slough as a sedimentation problem in the slough appears to have stabilized. In addition, modifying the inlet to Mosiman's Slough has the potential to create as many habitat problems as it would solve. No structural solution could be found for the sedimentation problem at the inlet to Willowcat Slough. Dredging would be a temporary solution that could not be justified at this time.

Environmental measures evaluated for the middle reaches of pool 5 were limited to stabilizing the Probst Lake inlet channel and the recommendations of the Weaver Bottoms Resource Analysis Program (RAP). Stabilizing the Probst Lake inlet channel under the St. Paul District's natural resource management program is recommended. This measure will prevent the channel from enlarging, eventually leading to degradation of winter habitat conditions in Probst Lake. The Weaver Bottoms RAP recommended stabilizing Roebuck's Run. This would be accomplished by the rock sill and bank stabilization discussed previously.

The Weaver Bottoms RAP recommended evaluation of drawdown as a habitat management measure. Further initiatives in this area fall under the purview of the Water Level Management Task Force of the River Resources Forum. The RAP recommended increasing side channel flow to Weaver Bottoms. The situation at Weaver Bottoms will continue to be monitored to see if existing side channel openings enlarge naturally. If this does not occur, or occurs at too slow a rate, enlarging the side channel openings by mechanical means can be pursued in the future.

The RAP recommended additional habitat islands be considered for Weaver Bottoms. Procedures are in place to pursue implementation of island construction in Weaver Bottoms under the District's channel maintenance program. In addition, the RAP recommended additional backwater dredging be conducted. This could be accomplished as part of obtaining topsoil for island construction in Weaver Bottoms.

The RAP recommends finding suitable sites for dredged material in pool 5. A long-term dredged material placement plan is in place for pool 5. However, the St. Paul District will continue to explore opportunities for alternative beneficial uses of dredged material such as the recommended island construction in the Lower Belvidere Slough area. The RAP also recommends that main channel hydrodynamics and sediment transport be optimized. The recommendations for the Roebuck's Run area address a localized problem. It appears that a large scale effort to optimize channel hydrodynamics and sediment transport in pool 5 is not practical. Making the channel more efficient would only aggravate the growing problem of dredging requirements occurring in lower pool 5 beyond present capability to reach designated placement sites using hydraulic equipment.

The RAP recommends that Roebuck's Run be stabilized which is part of the recommended plan from this study. The RAP recommends that the shoreline at Lost Island be stabilized. This will be accomplished as part of site management for the Lost Island containment site.

The RAP recommends further study and action to address sediment and erosion concerns in the Zumbro River and Whitewater River watersheds. Efforts in this area are considered beyond the scope of the St. Paul District's channel maintenance program.

The primary habitat restoration measure evaluated in lower pool 5 was island restoration in the lower Belvidere Slough area on the Wisconsin side of the navigation channel. A number of island locations, configurations and designs were evaluated. The recommended plan is to construct five small islands using channel maintenance dredged material. The island construction would be accomplished as part of normal channel maintenance, i.e., when a sufficiently large enough dredging job is identified, the material would be used to construct an island. The islands would be capped with fine material dredged from backwater areas, rock stabilization would be applied as needed, and the islands would be planted with grasses for stabilization. It would take 8-10 years to complete construction of the islands based on recent dredging frequencies and quantities in the area. Aside from the fish and wildlife habitat benefits provided, the use of dredged material in island construction would reduce channel maintenance costs.

All of the approximately 170 wing dams and closing dams in pool 5 were evaluated to determine if notching or other modifications of these structures would improve habitat conditions, primarily for fish and other aquatic life. Thirteen wing dams are proposed for notching to improve local bathymetric diversity. In addition, three other wing dams would be notched as part of the wing dam modifications proposed for the Roebuck's Run area.

The only site specific recreation measure evaluated was a sedimentation problem in Murphy's Cut, located at the upstream end of Weaver Bottoms. This sedimentation is affecting recreational boat access to and from the Half Moon Landing. No modification of channel control structures would solve this problem. A number of potential measures ranging from dredging to side channel structures were identified and evaluated. The lead agency in implementation of any solution would be the U.S. Fish and Wildlife Service.

In summary, a number of structural modifications including wing dam modifications, bank stabilization and a rock sill are proposed in pool 5 to solve channel maintenance, navigation, and environmental problems. In some instances, the proposed actions are designed to prevent problems from getting worse, or from occurring at all. The construction of five small islands in lower pool 5 is proposed to provide improved fish and wildlife habitat in a manner that will also result in reduced channel maintenance costs.

DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT

POOL 5 CHANNEL MANAGEMENT PLAN

UPPER MISSISSIPPI RIVER

BUFFALO CO., WISCONSIN AND

WABASHA AND WINONA CO., MINNESOTA

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POOL 5 CHANNEL MANAGEMENT STUDY

UPPER MISSISSIPPI RIVER

BUFFALO CO., WISCONSIN AND

WABASHA AND WINONA CO., MINNESOTA

INTRODUCTION

1.1 AUTHORITY

The Corps of Engineers is responsible for maintaining a navigable channel on the Mississippi River. Authority for continued operation and maintenance of the Mississippi River Nine-Foot Channel project is provided in the River and Harbor Acts of 1930 and 1932. Original authority for the Corps of Engineers to work on the Mississippi River was provided in the River and Harbor Act of 1878.

1.2 PURPOSE

One of many facets of the St. Paul District's approach to channel maintenance is to use channel control structures to reduce or control dredging requirements to reduce costs and the environmental effects associated with dredging. Other purposes are to provide a safer navigation channel, to use the river's energy for moving sediment to more strategic placement site locations, to reduce shoreline or dredged material placement site erosion that is affecting channel maintenance, and to correct channel maintenance situations that are causing adverse effects to other uses of the river. An important component of channel management is the identification and implementation of measures to reduce the adverse environmental effects of channel control structures and restore natural river processes and functions as much as possible. A related purpose of this program is to increase knowledge of sediment transport characteristics for applications to the dredging program. This should result in better decisions on dredging dimensions, predicting dredging requirements and understanding placement site effects. The program includes studies, repair, maintenance, and construction work related to wing dams, closing dams, shoreline protection, sediment traps, and other channel control features.

1.3 SCOPE

The Mississippi River is a dynamic, multidimensional resource valued and used for many purposes. It has been recognized by Congress as both a nationally significant ecosystem and a nationally significant commercial navigation system. The Pool 5 Channel Management study addresses channel management from a system perspective, considering fish and wildlife, recreational, and cultural resource problems and opportunities as well as channel maintenance and navigation problems and opportunities.

Channel management planning is taking place concurrently with other river resource planning efforts in such areas as water level management, recreation, and dredged material placement. These other planning efforts need to be taken into consideration as part of channel management planning. In the future it would be desirable to merge the results of these and previous studies in a comprehensive plan for river resource management.

1.4 STUDY AREA DEFINITION

The study area was defined in coordination with Federal and State agencies having management responsibilities on the Mississippi River. Factors considered in the definition of the study area included the channel maintenance area of interest, the scope of potential impacts of channel modifications, resource management objectives for the area, and consideration of the cumulative effects of all other related activities on the river. Hydrodynamic and sediment transport processes were also important considerations in the definition of the study area. Finally, practical considerations entered into the process, such as technical capabilities, time, and funding limitations.

The study area is defined as all of pool 5, extending from Lock and Dam 5 at river mile 738.2 to Lock and Dam 4 at river mile 752.8. The selection of the upper and lower limits for the study was based primarily on the fact that pool 5 is a relatively short pool and can be considered a single unit from a hydraulic analysis perspective.

The lateral boundaries of the study area are the limits of the river floodplain.

1.5 RELATED STUDIES/PROJECTS

The following studies and projects addressing channel maintenance, resource management, land use, and recreational planning in pool 5 have relevance to this study.

1.5.1 9-FOOT NAVIGATION CHANNEL PROJECT ENVIRONMENTAL IMPACT STATEMENT

This document, completed in 1974, assesses the environmental effects of the operation and maintenance of the 9-Foot Navigation Channel project within the St. Paul District.

1.5.2 GREAT RIVER ENVIRONMENTAL ACTION TEAM STUDY (GREAT I)

This 9-volume report (completed in 1980) documents the results of the 5-year Great River Environmental Action Team study for the St. Paul District reach of the Mississippi River. The report contained numerous recommendations for improved management of the river, the most important of which was a 40-year plan for dredged material placement for all of the historic dredging locations in the St. Paul District. Many of the study's recommendations have been implemented. Of particular application to this study is GREAT I further study item #2 which states - "A plan should be developed to use the river's sediment transport capability to cause necessary dredging requirements to occur near long-term placement sites as environmentally and economically feasible."

1.5.3 LAND USE ALLOCATION PLAN

This 1983 plan is the result of a joint effort by the St. Paul District and the U.S. Fish and Wildlife Service. The plan designates Federally owned land from the head of navigation to Lock and Dam 10 for one of five uses - (1) project operations, (2) recreation/intensive use, (3) recreation/low density, (4) natural area, or (5) wildlife management. Approximately 85 percent of the Corps fee-title land in pool 5 is designated for wildlife management use and approximately 8 percent for recreational use, with the remaining 7 percent designated for project operations.

1.5.4 UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE MASTER PLAN

The Master Plan for the Upper Mississippi River National Wildlife and Fish Refuge is the U.S. Fish and Wildlife Service's 20-year plan for development and management of the Refuge. This Master Plan was completed in 1987.

1.5.5 WEAVER BOTTOMS

This 1986 report recommended the construction of closures and islands to reduce flow into Weaver Bottoms and to reduce resuspension of sediments by wind and wave action. The islands

and sand closures were constructed of channel maintenance material taken from the Fisher Island and Lost Island dredged material containment areas. Construction of the project was completed in 1987. An extensive 10-year monitoring program has been conducted for the project. An interim report was completed in 1992 which discusses results of the first 5 years of monitoring. The final report of the monitoring program with recommendations was completed in 1998.

1.5.6 FINGER LAKES HREP

This 1990 report prepared under the Upper Mississippi River System - Environmental Management Program (UMRS-EMP) recommended the installation of three gated culverts in the lock and dam 4 dike to provide flows to four backwater lakes located below the dike. Construction of the project began in 1993 and was completed in 1994.

1.5.7 ISLAND 40 HREP

A study was conducted under the UMRS-EMP of the feasibility of stabilizing the head of Island 40 and dredging accumulated sand from Wiggle Waggle Slough for fish habitat improvement. It was concluded that the expected benefits of the project would likely not justify the costs and the project was placed in a deferred status.

1.5.8 ISLAND 42 HREP

This 1986 report prepared under the UMRS-EMP recommended the excavation of a side channel opening and the placing of a gated structure on the entrance to provided controlled flows to the backwaters in the interior of Island 42. In addition, the dredging of a portion of a backwater lake in Island 42 was recommended. Construction of the project began in 1986 and was completed in 1987.

1.5.9 SPRING LAKE PENINSULA HREP

This 1991 report prepared under the UMRS-EMP recommended repair of a breach in the barrier island chain at the upper end of Spring Lake for the purpose of reducing flows and sediment entering the lake. Construction of the project was completed in 1994.

1.5.10 SPRING LAKE ISLANDS HREP

A study is being conducted under the UMRS-EMP to evaluate the restoration of islands in Spring Lake. The study is scheduled to be completed in 1999.

1.5.11 CHANNEL MAINTENANCE MANAGEMENT PLAN

This 1996 plan and accompanying environmental impact statement is the St. Paul District's plan for management of channel maintenance. Much of the plan is devoted to the designation

and design of dredged material placement sites. Included in this report is the District's proposed program for channel management. This channel management study for pool 5 is part of that program.

1.5.12 POOL 5 RECREATIONAL BEACH PLAN

The St. Paul District in cooperation with river resource management agencies has been developing recreational beach plans for the navigation pools. The plan for pool 5 is scheduled to be completed in 2000. Data is available concerning which beaches in pool 5 are most heavily used.

1.5.13 RECREATIONAL BOATING STUDIES CONDUCTED IN 1989, 1991, 1993, 1995, AND 1997.

These reports document recreational boating data collected from aerial photography taken over the main channel and selected backwaters within the St. Paul District portion of the Upper Mississippi River. The data includes boat counts (both moving and beached, backwater or main channel), and boat types. The reports also summarize Corps of Engineers lockage data.

1.5.14 INTERAGENCY HYDRAULIC EVALUATION TEAM

The Interagency Hydraulic Evaluation Team (IHET) was created under the auspices of the River Resources Forum (RRF) to improve Mississippi River navigation channel planning and study, with emphasis on hydrodynamics and sediment transport. The IHET developed a set of draft guidelines for use in studies such as the Pool 5 Channel Management Study.

1.5.15 WATER LEVEL MANAGEMENT STUDY

Partial pool drawdown during the growing season has been identified as a potential tool for enhancing condition for the growth of aquatic vegetation, especially emergent aquatic vegetation which has been in decline in Upper Mississippi River navigation pools. A feasibility study for a pilot pool drawdown of pool 8 has been completed, recommending implementation of a drawdown in 2000. If implementation of a pilot drawdown in pool 8 shows that drawdown is a feasible management option for navigation pools within the St. Paul District, pool 5 would be a candidate for use of this measure in the future.

1.5.16 MINNESOTA 14 MODIFICATION

Minnesota 14 is the closure structure at the foot of Weaver Bottoms. This structure was constructed as part of the Weaver Bottoms Project. Water flowing through this structure from Weaver Bottoms into the main navigation channel is creating a cross current that affects navigability for barge tows. The structure was modified to alleviate this problem in 1997.

1.6 RELATED AUTHORITIES

1.6.1 SECTION 1135 OF WRDA 1986, AS AMENDED

Section 1135 of the Water Resources Development Act (WRDA) of 1986, as amended, authorizes the Corps of Engineers to modify Corps of Engineers water resource projects for the purpose of improving the quality of the environment. The following summarizes the basic provisions/guidance for Section 1135 projects.

a. If it is determined that construction or operation of a project constructed by the Corps of Engineers has contributed to the degradation of the quality of the environment, measures can be undertaken for restoration of environmental quality. Measures may be implemented either at the project site or at other locations that have been affected by the construction or operation of the project.

b. Section 1135 projects must be cost shared on a 75 percent Federal - 25 percent non-Federal basis.

c. The non-Federal sponsor is responsible for providing all lands, easements, and rights-of-way, and for project operation and maintenance in most instances.

d. The acquisition of additional lands should be kept to a minimum.

e. The Federal cost limit per project is $5,000,000 ($6,666,666 total project cost).

f. The Section 1135 project must be consistent with the authorized purpose of the project.

g. Study-only proposals will not be funded.

h. Studies that may result in an operational-only change which can be accomplished without additional cost should be pursued under operation and maintenance or other authorities.

1.6.2 SECTION 204 OF WRDA 1992, AS AMENDED

Section 204 of the Water Resources Development Act of 1992 authorizes the Corps of Engineers to carry out projects for the protection, restoration, and creation of aquatic and ecologically related habitats, including wetlands, in connection with construction, operation, or maintenance of an authorized Federal navigation project. In essence, this authority provides for the use of dredged material for the improvement of aquatic and ecologically related habitats. The following summarizes the basic provisions/guidance for Section 204 projects.

a. Section 204 projects are cost shared on a 75 percent Federal -25 percent non-Federal basis.

b. The non-Federal sponsor is responsible for providing all lands, easements, and rights-of-way, and for project operation and maintenance.

c. Section 204 costs are limited to the incremental costs in excess of those costs necessary to maintain the navigation project in the most cost effective way, consistent with economic, engineering, and Federal environmental criteria. For example, if it would cost $100,000 to place dredged material in an acceptable placement site and $150,000 to place the dredged material in a manner that would improve aquatic habitat, the non-Federal sponsor would be required to cost-share only the $50,000 incremental cost needed to obtain the habitat benefits.

1.6.3 SECTION 206 OF WRDA 1996

Section 206 of the Water Resources Development Act of 1996 authorizes small aquatic ecosystem restoration projects. Projects must be cost shared on a 65 percent Federal - 35 percent non-Federal basis. The non-Federal sponsor must also assume responsibility for the operation and maintenance of the project. As opposed to Section 1135 authority, no linkage to an existing Corps of Engineers project is required.

1.6.4 SECTION 1103 OF WRDA 1986, AS AMENDED

Section 1103 of the Water Resources Development Act of 1986, as amended, authorized what is commonly referred to as the Upper Mississippi River System Environmental Management Program (UMRS-EMP). An important component of the UMRS-EMP is the Habitat Rehabilitation and Enhancement Projects (HREP) program. Under this program, habitat projects are being constructed throughout the Upper Mississippi River system. Projects constructed within a National wildlife refuge are constructed at 100 percent Federal cost. Projects constructed on non-refuge lands must be cost shared by a non-Federal sponsor. The authorization for the UMRS-EMP expires in 2002. Bills are pending in congress that would reauthorize the UMRS-EMP.

EXISTING SETTING

2.1 PHYSICAL SETTING

Pool 5 is part of the Upper Mississippi River system and was created in 1935 by the completion of Lock and Dam 5. The entire pool is about 23.5 kilometers long, extending from river mile 738.1 to river mile 752.7. The target pool elevation is 660.0 feet above mean sea level. Pool surface area is 4,835 hectares at this elevation.

Several tributaries empty into the Mississippi River within the pool. Many of these tributaries are small perennial to intermittent streams. Two large tributaries, the Whitewater and Zumbro Rivers, enter pool 5 from Minnesota and strongly influence water quality.

The river meanders across a broad floodplain. The navigation channel in pool 5 is generally located on the Minnesota side of the floodplain from Lock and Dam 5 to about river mile 742.5. From that point, the navigation channel shifts toward the center of the floodplain and generally remains there until river mile 751, where it begins to shift to the Wisconsin shoreline for the approach to Lock and Dam 4. A major feature of pool 5 is Weaver Bottoms, a 1,600-hectare backwater area located on the Minnesota side of the main channel between river miles 742.5 and 746.5.

2.2 WATER RESOURCES

2.2.1 UPPER MISSISSIPPI RIVER

Early summer (June) discharges at Lock and Dam 5 generally range from 850 to 1,550 cubic meters per second (cms) (30,000 to 55,000 cubic feet per second (CFS)). By late summer, discharges usually decrease to a range of 425 to 1,150 cms (15,000 to 40,000 cfs). Winter low flows are usually in the range of 425 to 700 cms (15,000 to 25,000 cfs). Project pool elevation for pool 5 is 660.0. Table 2-1 shows the discharges and stages associated with the various high runoff events for the Mississippi River at Lock and Dam 5.

Table 2-1
Mississippi River Discharge Frequencies - L/D 5

Event	Last Occurrence	Flow	L/D 5 Pool Elev.	L/D 4 Tailwater
5-year (20% chance)	April 1997	3,483 cms	660.1	668.2
10-year (10% chance)	April 1997	4,248 cms	662.2	669.9
50-year (2% chance)	April 1969	6,032 cms	666.0	673.5
100-year (1% chance)	April 1965	6,938 cms	667.6	675.0

2.2.2 ZUMBRO RIVER

The Zumbro River has a watershed of approximately 3,575 square kilometers, draining a watershed in southeastern Minnesota with a large portion in agricultural use. The Zumbro River at times can contribute a substantial amount of suspended sediment to the Mississippi River. The Zumbro River contributes about 133,000 metric tons/year of sand to pool 5 (Colorado State University 1979). This is about 27 percent of the sand inflow to the pool.

2.2.3 WHITEWATER RIVER

The Whitewater River has a watershed of approximately 780 square kilometers. The Whitewater River enters the lower reaches of Weaver Bottoms. The Whitewater River at times can contribute a substantial amount of suspended sediment to the Mississippi River. The Whitewater River contributes a modest amount of bed load sediment to the Mississippi River. Bed material sediment from the Whitewater River does not affect dredging requirements in pool 5. Coarse sediments from the Whitewater River are trapped in Weaver Bottoms.

2.2.4 WEST NEWTON CHUTE

West Newton Chute is a major secondary channel located in the upper reaches of pool 5. It branches off the navigation channel to the right at about river mile 749.8 and rejoins the navigation channel at about river mile 747.6. West Newton Chute conveys about 22 percent of the total river flow.

2.2.5 BELVIDERE SLOUGH

Belvidere Slough is a major secondary channel branching off the navigation channel to the left at about river mile 748.0. The slough conveys about 26 percent of the total river flow. The slough initially flows toward the Wisconsin shoreline and then follows that shoreline down past Buffalo City, Wisconsin. Below Buffalo City, Belvidere Slough swings back toward the main channel. In this area, bordering islands have been lost to erosion; however, the slough generally retains a defined channel through this open water area. On some maps, Belvidere Slough is shown as Pomme De Terre Slough. This report will use Belvidere Slough as that is the most commonly used name.

2.3 GEOLOGY

Most of pool 5 is in an area not covered by the last glaciation. Pool 5 is underlain by relatively flat-lying Cambrian and Ordovician sandstone, limestone, and dolomite. These rocks were formed from sediment deposited by successive marine inundations occurring between 400 million and 600 million years ago. The sediments were later compacted and cemented forming sedimentary rock. The sandstones have a combined thickness of more than 120 meters. They typically are poorly cemented and are easily eroded. They have a high porosity and permeability and are thus important aquifers in the basin. The sandstones are usually overlain by massive limestone or dolomite rocks as much as 30 meters thick. The limestone and dolomite are more resistant to erosion and are found capping bluffs and cliffs. The Minnesota bluffs are primarily north or east facing, thus snow does not melt off during winter months. Because of the increased moisture, they are generally heavily timbered. By contrast, the Wisconsin bluffs are primarily south or west facing, causing drier conditions which support less timber and result in grassier slopes, known as "goat prairies."

The most significant geological event explaining the nature of the Mississippi River within pool 5 occurred at the end of the Pleistocene glaciation approximately 10,000 years ago. Tremendous volumes of glacial meltwater, primarily from the Red River Valley's glacial Lake Agassiz, eroded the preglacial Minnesota and Mississippi River valleys. As meltwaters diminished, the deeply eroded river valleys aggraded substantially to about the present levels.

Since post-glacial times, an anastomosing stream environment has dominated this reach of the Mississippi River, due to the river's low gradient and oversupply of sediment from its tributaries. Prior to the impoundment of pool 5 in the 1930's, the broad floodplain of the river was characterized by a stream system that consisted of multiple channels, swampy depressions, sloughs, natural levees, islands, and shallow lakes.

The soils of pool 5 are alluvial and vary in texture from silty clay to sand. The most common soil associations include Abscota-Glendora-Kalmarville, Comfrey-Shiloh, Stony and Rocky Land-Seaton-Boone, and LaCrescent-Elbaville-Lamoille. The composition of the soil depends upon the manner in which the soil was laid down. The strata are composed of clay, silt, sand and gravel and are very irregular. Most of the upland surrounding pool 5 is mantled with loess: a wind-blown silt deposit several meters thick. The silt was eroded from glacial drift during the later part of the Pleistocene Ice Age. Stream banks plainly show the varying thickness of the different materials and in many places the lack of continuity of the sand and gravel layers above low water level. The loess is easily eroded and thus large amounts are eroded by streams each year. Sand and gravel strips border most sloughs, but some of the larger, more elevated areas between the sloughs are covered with heavy, silty loam which is underlain with sand or gravel.

2.4 WATER QUALITY

Pool 5 of the Mississippi River has variable water quality. On the east side of the valley, water quality is good with low levels of suspended solids, reflecting the influences of Lake Pepin and the Chippewa River. However, the Zumbro and Whitewater tributaries entering on the west side of pool 5 drain predominately agricultural areas and add extensive loads of suspended solids and agricultural chemicals.

Except for isolated sloughs and backwater lakes, the dissolved oxygen content of the water remains high year round and above levels required to sustain a quality fishery. In an isolated area immediately below Lock and Dam 4, Finger Lakes, aeration culverts were recently added to the lock and dam dike to correct problems with dissolved oxygen. Because of its turbulent nature, the river is well aerated and it can assimilate a considerable biochemical oxygen demand (BOD) loading. Fertility levels (nitrogen, phosphorus, potassium, calcium, etc.) are ample to support luxuriant growth of rooted aquatics and algae. Mead (1995) in their investigations of contaminants in the Mississippi River from 1987 to 1992 found water quality to be generally better in this reach of the River than above Lake Pepin and in the reach downstream where tributaries that drain the Corn Belt begin to enter the Mississippi River.

Sediment quality is generally good in pool 5. Main channel sediments are primarily medium to coarse sands with only trace amounts (generally less than 3 percent by weight) of silts and clays. Backwaters sediments consist of fine material and sand. Levels of pesticides and other chlorinated hydrocarbons were generally below detection limits in all main channel and backwater samples that have been tested. PCB's have been detected in backwaters, but were generally less than 10 parts per billion. Selected heavy metals and nutrients were found in relatively low concentrations in the sediment samples that have been analyzed in pool 5.

2.5 VEGETATION

Vegetation in pool 5 shows an overlapping of eastern and western species. Several high "sand prairie" areas are scattered along the river valley forests, offering habitat conditions normally found much farther west. The climate moderation also allows more southern plant species to extend their ranges up the river valley.

Forested areas in the region are of two types; upland xeric southern forests, and lowland forest of the floodplain. The small amount of upland forest is found at the edge of the Richard Dorer Memorial Forest. Forested areas are primarily wetland forests area found on river islands and riparian shorelines. Pool 5 contains about 2,400 hectares of wetland forest habitats. These forests are typically seasonally flooded. The soil is without standing water during most of the growing season, but is waterlogged within at least 10 centimeters of the surface. Dominant tree species in the floodplain forest type are river birch, cottonwood, silver maple, and black willow. American elm was once a dominant species in the floodplain forest; however, the occurrence of this species has been greatly reduced due to Dutch elm disease. Species that dominate in the better drained areas are American elm, silver maple, green ash, basswood, and black ash.

Inland fresh meadows are similar to wetland forests in that their soils are waterlogged. Vegetation found on fresh meadows includes sedges, rushes, redtop, reed grasses, cattails, manna grasses, prairie cordgrass and mints.

Three classes of fresh marsh wetlands, shallow, deep, and open water, can be found in the floodplain of pool 5. They mostly occur along major tributaries, on islands, or on peninsulas located throughout the river segment and within the channel of the Mississippi. In the mid-1970's, pool 5 contained about 1,560 hectares of marsh wetland. Fresh marsh soils are usually waterlogged during the growing season. Water depths vary from 0.15 to 3.0 meters. Since inundation however, the amount of vegetation has fluctuated and gradually declined reducing many backwater marshes to open, windswept, riverine lakes. Emergent vegetation in these wetlands include grasses, bulrushes, spikerushes, cattails, arrowheads, smartweeds, coontail, water lilies and spatterdocks. Phragmites also is present and provides important cover for wildlife. Submergent vegetation includes American wild celery, coontail, milfoil, water stargrass, and sago pondweed.

2.6 FISH AND WILDLIFE

Pool 5 has good, diverse habitat for both fish and wildlife. Habitat types present in pool 5 include most of the classifications of Wilcox (1993). The most prevalent aquatic habitats in pool 5 include main channel, channel border, slough, river lakes, and tailwater. The important characteristics of these habitat types, relative to fish and wildlife uses are described below.

Main channel - The main channel usually conveys the majority of the river discharge and in most reaches includes the navigation channel. It has a minimum depth of 2.7 meters and a minimum width of 122 meters. A current always exists, varying in velocity with water stages. The bottom type is mostly a function of current. The upper section usually has a sand bottom, changing to silt over sand in the lower section. Patches of gravel are present in a few areas. No rooted vegetation is present. Pool 5 contains about 235 hectares of main channel habitat.

Main channel border - Main channel borders are the areas between the navigation channel and the river bank. Channel borders contain the channel training structures (wing dams, closing dams, revetted banks) and thus a diversity of depths, substrates, and velocities can be found in this habitat type. The bottom is sand in the upper section of the pool and silt in the lower. Definable plant beds are frequently absent, but single species submersed plant clusters are sparsely scattered in areas of reduced current. Pool 5 contains about 655 hectares of main channel border habitat.

Secondary channel - Secondary channels are large channels that carry less flow than the main channel. Undercut or eroded banks are common along the channels' departure from the main channel. The bottom type usually varies from sand in the upper reaches to silt in the lower. In the swifter current there is no root vegetation, but vegetation is common in the shallower areas having silty bottoms and moderate to slight current. Pool 5 contains about 450 hectares of secondary channel habitat.

Sloughs - Sloughs are characterized by having no current at normal water stage, mud bottoms, and an abundance of submerged and emergent aquatic vegetation. Pool 5 includes about 1,400 hectares of slough including the backwaters of the Weaver Bottoms and Belvidere Slough. These areas provide excellent spawning, nesting, and rearing areas, although sedimentation and loss of vegetation are causing a decline in the fish and wildlife habitat values of these areas.

River Lakes and Ponds - River lakes and ponds are distinct lakes formed by fluvial processes or are artificial (excavated or impounded). They may or may not have a slight current, depending on their location. Most of the bottoms are mud or silt, often consisting of a layer two or more feet thick. Aquatic vegetation in these bodies of water can be highly variable. Emergent vegetation is generally restricted to the perimeter of these water bodies. Pool 5 contains about 1,155 hectares of river lakes and pond habitat.

Tailwaters - Tailwaters are the areas downstream of the navigation dams with deep scour holes, high velocity, and turbulent flow. The bottom is mostly sand. No rooted vegetation is present. Pool 5 contains about 30 hectares of tailwater habitat.

2.6.1 WILDLIFE

The numerous backwater areas such as Weaver Bottoms, Belvidere Slough, and Mosiman's Slough interspersed with forested islands provide good habitat for a variety of wildlife species. Relatively abundant species include white-tailed deer, gray fox, raccoon, beaver, muskrat, mink, and cottontail rabbit. Less abundant species would include otter, opossum, and gray and fox squirrels. The Upper Mississippi River National Wildlife and Fish Refuge provides high quality wildlife habitat in this reach.

Backwater areas and lake type habitats provide important habitats for bald eagles and significant numbers of waterfowl each year. Waterfowl use in general has declined, likely due to a combination of lower overall waterfowl populations and changing habitat conditions on the Upper Mississippi River. The backwater areas of Weaver Bottoms and Belvidere Slough provide important habitats for canvasback ducks, common moorhens, and Forster's terns. Use of Weaver Bottoms by diving ducks and tundra swan has declined in recent years. However, use by dabbler ducks and Canada geese has remained fairly constant. Great egrets and blue herons are the most common wading birds to use the area. Spotted sandpiper, killdeer, and black terns nest within Weaver Bottoms. Other shorebirds and gulls that use the area include sandpipers, herring gulls, and ring-billed gulls. Large numbers of pelicans and cormorants also use the Weaver Bottoms area.

The sand prairie and marsh areas north of Weaver bottoms provide habitat for a species of rare turtle and many species of waterfowl. Diverse wetlands in the McCarthy Lake WMA provide important habitat for Blanding's turtle, a state endangered species. In addition, a small population of sandhill cranes nests in the McCarthy Lake WMA. A large heron rookery is found in the Zumbro River bottoms.

The floodplain of pool 5 provides habitat for a wide variety of amphibians and reptiles. Species found in the floodplain and adjacent sand prairies include the snapping turtle, map turtle, false map turtle, Blanding's turtle, painted turtle, smooth softshell, spiny softshell, northern water snake, eastern garter snake, bullsnake, fox snake, eastern tiger salamander, American toad, gray treefrog, western chorus frog, green frog, and leopard frog.

2.6.2 FISH

The continuum of aquatic habitats ranging from fast flowing main channel to lotic backwaters is present which provides for a great diversity and abundance of fish. UMRCC (1983) lists 83 species of fish that have been recorded from pool 5. Common sport fish include walleye, sauger, yellow perch, white bass, bluegill, black crappie, smallmouth bass, largemouth bass, and northern pike. The most common rough fish include common carp, shorthead redhorse, spotted sucker and freshwater drum. The most common forage fish include gizzard shad and spottail shiner.

Wisconsin Department of Natural Resources fish managers believe Lock and Dam 5 provides the most significant barrier to fish passage of the navigation dams on the Upper Mississippi River (see later discussions concerning this subject in this report).

2.6.3 AQUATIC INVERTEBRATES

There is a large assemblage of invertebrate species within the pool. The varied invertebrate fauna is due to the wide variety of habitats in the area. Lake forms of invertebrates find suitable habitat in the lentic portions of the pools. Organisms which require running water find a wide range of water velocities in the tailwaters, main channel, along the wing dams, and in side channels. The rocks associated with wing dams and shoreline protection provide a suitable habitat for specialized invertebrates.

2.6.3.1 Mussels

The pool also supports various species of mussels. The threeridge, pimpleback, pigtoe, and threehorn are common in this reach. Minor species of mussels in this reach includes the purple pimpleback and purple pocketbook. In Wisconsin, it is legal to commercially harvest the threeridge, pigtoe, pimpleback and mapleleaf. In Minnesota, the only mussel species legal to harvest is the threeridge. The zebra mussel is present in pool 5 and its numbers have steadily been increasing since its first reported occurrence in 1991. The impacts of zebra mussels are still unclear but it generally thought to be deleterious.

2.6.3.2 Insects

Burrowing mayflies are abundant along much of the Mississippi River. Nymphal forms of the three major species (Hexagenia bilineata, H. limbata, and Pentagenia vittigera) are efficient detritivores and an important food organism for many species of fish.

2.7 THREATENED AND ENDANGERED SPECIES

The peregrine falcon (Falco peregrinus), and bald eagle (Haliaetus leucocephalus) are Federally-listed wildlife species that may occur in pool 5. The peregrine falcon (listed as endangered) may use the area during migrations but no active nesting sites are known to exist in the immediate vicinity. A historic peregrine falcon nesting site is located on the cliffs in Latch State Park. This site was last occupied in 1988.

Early in the fall until freeze up, bald eagles (listed as threatened) gather in the Weaver Bottoms area. Bald eagles also make use of the tailwaters as winter feeding areas. There are three active bald eagle nesting sites in pool 5 that have produced fledglings over a number of years. Bald eagles have an established winter night roost (November - April) in the backwater of the Zumbro River. They feed along the main channel during the day, and at night roost in the river bottoms just downstream of the Finger Lakes.

Eleven aquatic species with state protected status occur in this reach of the Mississippi River. Nine of these species are fish and two are mussels (table 2-2). The Higgins' eye pearly mussel (Lampsilis higginsi) is listed as Federally endangered. However, it has not been recorded in recent times in pool 5 or in adjoining pools. None of the fish species have Federal protection nor are they listed threatened or endangered in Minnesota. However, the paddlefish has been identified by the USFWS as a potential candidate.

Five protected species of plants occur in this reach. All but one are Wisconsin state-threatened species found in Buffalo County, Wisconsin. The rough-seeded flameflower found in Wabasha, Minnesota is a state endangered plant. None of the plants are Federally-listed. The plant species are listed in table 2-2.

Four additional species are listed with protected status (table 2-2). The sand prairie and marshland north of Weaver Bottoms provide habitat for the loggerhead shrike. Thirteen occurrences of the Blanding's turtle have been reported within pool 5 near the McCarthy Lake WMA. The largest known population of Blanding's turtles is in and along pool 5. The Ottoe skipper butterfly is an upland species.

Table 2-2
Protected Species of Pool 5 of the Upper Mississippi River

Species	Federal Status	Wisconsin Status	Minnesota Status
Peregrine Falcon	endangered	endangered	endangered
Bald Eagle	threatened	threatened	threatened
Loggerhead Shrike	---	---	threatened
Blanding's Turtle	---	threatened	threatened
Wood Turtle	---	threatened	threatened
Black Buffalo	---	threatened	special concern
Blue Sucker	---	threatened	special concern
Crystal Darter	---	endangered	special concern
Goldeye	---	endangered	---
Greater Redhorse	---	threatened	---
River Redhorse	---	threatened	---
Pallid Shiner	---	endangered	special concern
Speckled Chub	---	threatened	---
Paddlefish	candidate	threatened	threatened
Skipjack Herring	---	---	special concern
Lake Sturgeon	---	---	special concern
Pirate Perch	---	---	special concern
Yellow Bass	---	---	special concern
Higgins' Eye Pearly Mussel	endangered	---	---
Rockshell	---	---	endangered
Bullhead	---	---	endangered
Monkeyface Mussel	---	threatened	threatened
Washboard	---	---	threatened
Ohio River Pigtoe	---	---	threatened
Buckhorn	---	---	threatened
Spike	---	---	special concern
Fluted Shell	---	---	special concern
Black Sandshell	---	---	special concern
Hickorynut	---	---	special concern
Ottoe Skipper Butterfly	---	---	threatened
Clustered Broomrape	---	threatened	---
Prairie Thistle	---	threatened	---
Tubercled Orchid	---	threatened	---
White Lady's Slipper	---	threatened	---
Rough-seeded Flameflower	---	---	endangered

2.8 CULTURAL RESOURCES

Of the 22 archeological sites known in this pool, 19 of these are in Wabasha County, Minnesota. There are no archeological sites within pool 5 that have been placed on the National Register. Of the historical sites within pool 5, 24 historic properties are located in Wisconsin, with most in the communities of Alma, Buffalo, and Cochrane in Buffalo County, Wisconsin. Three properties are on the National Register. A multiple-resource district for Alma, which includes some archeological sites, is also on the National Register. Only one historic site within pool 5 has been recorded for Minnesota. A shoreline cultural resources survey made in 1997 (Thomas C. Pleger, 1997, *A Phase I Archaeological Survey of the Floodplain of Pool Nos. 5, 5A, and 6 of the Upper Mississippi River Valley,* The Mississippi Valley Archaeology Center at the University of Wisconsin-La Crosse, Reports of Investigations No. 248) found only one additional site in Pool 5. This newly recorded site is 47 BF 206, an historic EuroAmerican building foundation on the Wisconsin shore.

There are six archeological sites in the area of West Newton Chute and Weaver Bottoms. These sites range from the Woodland era mounds to historic lumber rafting sites. Given the extent of prehistoric Indian and historic lumbering activities in the Weaver area, the potential for cultural resources is high. However, before inundation by Lock and Dam 5, most of the Weaver Bottoms area had been low-lying marsh and bottomland forest, and the likelihood of finding cultural resources in the project area is small. The changes to Weaver Bottoms since inundation make the likelihood of finding intact cultural resources even smaller.

Pool 5 also contains a number of cultural resources, as yet unevaluated in terms of their eligibility for the National Register of Historic Places, associated with the navigation channel itself. These include historic shipwrecks and wing dams. At least four shipwrecks are known for pool 5. Three of these (the earliest is the 1853 wreck of the West Newton) are at the foot of West Newton Chute, evidently a hazardous bend for navigation for decades. The wing dams of pool 5 are also associated with the early history of Euro-American transport on the river. Wing dams in pool 5 were built as part of several Corps of Engineers projects to improve navigation on the river: the 1.4-meter channel built between 1878-1906 and the 1.8-meter channel authorized in 1907.

2.9 SOCIOECONOMIC SETTING

Alma and Buffalo City, Wisconsin are the largest communities on the pool. The village of Minneiska is the largest Minnesota community bordering the pool. Adjacent larger Minnesota communities are Wabasha, located 16 kilometers upstream, and Winona, located 40 kilometers downstream. The pool is also adjacent to Buffalo County on the Wisconsin side of the river.

Despite the sparsity of river communities, pool 5 is not isolated. Primary highways either closely parallel the shorelines for considerable distance along both sides of the pool or follow the

nearby high-terraced areas within the valley in the same general north-to-south direction. Networks of secondary, county, and township roads connect with the primary roads to service the areas adjacent to the pool and to provide access from outlying areas. Railroads closely parallel the primary highways on both sides of the pool. No highway or railroad crossings from Minnesota to Wisconsin are located on pool 5. Neither airline service nor small airports are available in the immediate area. There are two commercial navigation facilities in pool 5; one just downstream from Alma, Wisconsin at R M. 751.5 LB and the second near Indian Point at R. M. 748.0 LB.

Agriculture encompasses the largest single land use in this reach. Large tracts of agricultural land are found in Buffalo County, Wisconsin, and between the river and the Richard Dorer Memorial Forest in Minnesota. Pool 5's only commercial dock handles coal for an electric utility company, the Dairyland Power Co-op. More significantly, pool 5 serves as a thoroughfare for the river traffic between the region south of pool 5 and the Twin Cities.

2.10 RECREATION

Recreation activities in pool 5 include fishing, recreational boating, hunting, trapping, camping, birdwatching, canoeing, island beach use and sightseeing, primarily at lock and dam observation decks. Pool 5 provides 11 boat accesses with a total of 13 launching lanes (7 in Wisconsin and 6 in Minnesota), 227 parking spaces, 12 marina slips, 16 rental boats, 141 camping units, and 43 picnic units. The dredged material disposal islands along the main channel throughout the pool are popular with recreational boaters. Weaver Bottoms historically has been one of the most heavily used waterfowl hunting areas on the Upper Mississippi River. Compared to other areas, pool 5 provides fair to good hunting and trapping opportunities.

Pool 5 contains federal and state management areas, parks, refuges, and recreation areas. Two major parks near the pool are John Latsch State Park in Minnesota and Buena Vista Park in Wisconsin. John Latsch State Park, developed and operated by the State of Minnesota, overlooks pool 5 from the bluff area just upstream from Lock and Dam 5.

The Upper Mississippi River National Wildlife and Fish Refuge provides high quality wildlife habitat in this reach. The backwater areas of Weaver Bottoms and Belvidere Slough provide good waterfowl hunting and trapping. Mosiman's Slough is one of the most heavily fished areas in pool 5, particularly during the winter icefishing season. The 367 hectare Kellogg-Weaver Dunes Minnesota State Natural Area located in Wabasha County is a significant sand prairie grassland ecosystem. Many of the surrounding bluffs and valleys in Minnesota are part of Richard J. Dorer Memorial State Forest, which covers 17,400 hectares in Wabasha County.

Area	State	County	Hectares	Type
Richard J. Dorer Memorial State Forest	MN	Wabasha	17,400	S
John Latsch State Park	MN	Winona	135	S
Buena Vista Park	WI	Buffalo	ND	L
Kellogg-Weaver Dunes State Natural Area	MN	Wabasha	367	S
Upper Mississippi River National Wildlife & Fish Refuge	MN,WI	All		F
Whitewater State WMA	MN	Wabasha/ Winona	11,125	S
McCarthy Lake Wildlife Area	MN	Wabasha	1,150	S

Type: Federal (F), State (S), Local (L) ND=No Data

HISTORIC CHANGES

This section summarizes changes to pool 5 brought about by various navigation projects and other Federal activities. The purpose is to provide a background for the current conditions in pool 5. It is not intended as a detailed description of all the changes that have occurred to the Mississippi River and its basin since European settlement.

3.1 EARLY NAVIGATION PROJECTS

The first navigation modifications and maintenance on the Upper Mississippi River were legislated by Congress in 1824, when the Corps of Engineers was authorized to remove snags, shoals, and sandbars, and to close sloughs and backwaters so that flows were confined to the main channel to maintain depths for navigation.

The first comprehensive modification of the river for navigation was authorized by the River and Harbor Act of 1878. This legislation authorized a 1.4-meter channel from the mouth of the Missouri River to St. Paul, Minnesota. The 1.4-meter channel was maintained by constructing dams at the headwaters of the Mississippi River to impound water for low flow supplementation, bank revetments, closing dams, and longitudinal dikes. A 1.8-meter navigation project was authorized by the River and Harbor Act of 1907. The additional depth for the 1.8 meter channel was obtained by increased construction of wing dams supplemented by limited dredging. Usually the banks opposite a wing dam field were protected with rock revetments to prevent erosion.

Available records show that a total of about 150 wing dams, 18 closing dams, and 4 trailing dams were constructed in the study area. (Trailing dams are rock structures generally constructed off the lower ends islands, usually oriented parallel to the main channel.) A large percentage were repaired and/or modified in the early 1900's. In the 1930's, 2 wing dams were removed. Approximately 16 kilometers of rock revetment were constructed in the study area.

These early navigation structures were designed to confine flow to the main channel. The closing dams would have reduced flow down side channels and, in combination with the wing dams, increased velocity and sediment transport in the main channel, resulting in a deeper channel. Sediments accreted between wing dams and in cut off side channels, converting aquatic habitat to terrestrial habitat. This accretion and conversion is readily evident on pre-lock and dam aerial photographs.

3.2 NATIONAL WILDLIFE REFUGE

The Upper Mississippi River National Wildlife and Fish Refuge was authorized in 1924. The immediate effect of creation of the Refuge was the purchase of land for fish and wildlife management. The authorization of the 9-Foot Navigation Channel project in 1930 halted large scale purchases of land for the Refuge. Had this navigation project not come about, one of the major effects of the Refuge would likely have been the prevention of levee construction and conversion of large portions of the floodplain to agriculture as has occurred in the lower Zumbro River, Whitewater River, and the more southern reaches of the Upper Mississippi River.

3.3 9-FOOT NAVIGATION CHANNEL PROJECT

The River and Harbor Act of 1930 authorized the 9-Foot Navigation Channel project and led to the construction of a series of locks and dams to provide the necessary water depths. Land that would be affected by the increased water levels was purchased. The Corps purchased approximately 3,060 hectares in pool 5. About 2,910 hectares of this land are managed as part of the Upper Mississippi River National Wildlife and Fish Refuge under a cooperative agreement between the Corps and the Service.

Lock and Dam 5 was completed in 1935. The dam has a head of 2.7 meters at normal project pool elevation 660.0. Normal tailwater elevation is 651.0. Creation of the pool inundated thousands of acres of land. A study published by the Corps of Engineers (1978) showed the changes in habitat types in pool 5 between 1929 and 1973 (table 3-1).

The effects of creation of the navigation pools have been described in many other studies. They can be synopsized as follows. Creation of the navigation pools created thousands of acres of new aquatic habitat, benefiting those forms of fish and wildlife adapted to this habitat. Major beneficiaries were lentic fish species, waterfowl, marsh and other water birds, and furbearers. Adversely affected were terrestrial wildlife and lotic fish species. The period from creation of the locks and dams through the late 1950's could be termed an "era of plenty" due to the abundant fish and waterfowl resources generated by the newly created aquatic habitats.

As soon as the navigation pools were created, natural processes began to transform them. During the "era of plenty" noted above, these transformations either were not noticed, or were not given much concern by the public. In the 1960's, resource managers and the public began to take more notice of these natural changes, most specifically the filling of backwater habitats with sediments. Sedimentation was probably the most significant resource concern in the 1960's and 1970's, and still is an important concern.

Table 3-1
Changes in Hectares of Habitat Types for Pool 5
1929 - 1973

Habitat Type	1929	1973	Net Change*
Main Channel	448	234	- 214
Main Channel Border	207	657	+ 450
Side Channels	0	449	+ 449
Sloughs	549	1,401	+ 852
River Lakes and Ponds	84	1,156	+ 1,072
Tailwaters	0	31	+ 31
Marsh	456	1,559	+ 1,103
Total Aquatic	1,744	5,487	+ 3,743
Forest	2,935	2,410	- 525
Brush	746	131	- 615
Meadow	2,512	1,156	- 1,356
Sand	625	110	- 515
Agriculture	4,061	3,130	- 931
Residential/Commercial	125	674	+ 549
Total Terrestrial	11,004	7,611	- 3,393

* totals do not balance as the study areas used for the two years differed by about 350 hectares

Within the last 20 years, other changes associated with impoundment have become the subject of concern. Some of the more significant are:

a) disruption of the annual hydrograph, as well as the attenuation of hydrograph extremes, especially during drought or low water conditions

b) disruption of the hydraulic processes that would occur in an unimpounded or unconstrained river

c) declines in aquatic vegetation

d) declines in bathymetric diversity

e) forest stand uniformity and succession changes related to a) and b) above

f) loss of islands

All of these have applicability in pool 5. The natural hydrograph has been disrupted by the creation and regulation of pool 5. Regulation of the pool can attenuate minor high water events, but generally, there is little or no effect on larger flood events. More significant is that maintenance of the pool creates a relatively fixed low water elevation. Water levels do not decline below this point during annual low water periods or during droughts. This interrupts natural physical and biological processes associated with and/or requiring periodic low water. Impounded areas above the navigation dams experience a leveling effect due to wind wave action eroding the high points and trapped sediments filling in old channels.

The hydraulic processes that would occur in an unimpounded or unconstrained river have also been disrupted. Wing dams, closure structures, and bank protection are all designed to constrain flow to the main channel. This reduces flow to side channels and other backwater areas. It also constrains the river from creating new side channels or sloughs, and from building of new islands and channel levee landforms.

3.4 WEAVER BOTTOMS PROJECT

The Great River Environmental Action Team (GREAT) I was organized in 1973 to identify and assess the problems associated with the multipurpose use of the UMR and develop recommendations for improved management of the UMR's resources. One of the areas studied by the GREAT I team was the deteriorating habitat quality of the Weaver Bottoms, a 1,600-hectare backwater lake in pool 5. A dramatic decline in marsh vegetation and the inability of the marsh to recover was attributed to a variety of reasons, including two major floods in the 1960's, uprooting and removal of plants by ice, changed flow and sedimentation patterns, and reduced water clarity caused by wind-induced wave resuspension of sediments. As a result the Weaver Bottoms Rehabilitation Project was designed to 1) reduce flows entering the backwater by modifying side channels and 2) reduce wind fetch and resuspension of sediments by creating barrier islands. A third goal was to provide a long-term channel maintenance plan for lower pool 5.

The Rehabilitation Project was designed to be completed in two phases. Phase I, completed in 1987, included partial or complete closures of secondary channels into Weaver Bottoms and two islands in the open water area of Weaver Bottoms. Phase II (construction of additional islands and/or other measures) was to be implemented only after the effects of the Phase I effort was thoroughly evaluated through the comprehensive 10-year interagency Resource Analysis Program (RAP) that was established to evaluate the effects of the project. An interim report on the RAP was published in 1992. Major conclusions of the interim report were that the project 1) significantly altered flow and sedimentation patterns in lower pool 5; 2) has had very little influence on habitat quality for vegetation or fish and wildlife in Weaver Bottoms or in adjacent areas of pool 5; and 3) additional monitoring and special studies were necessary to evaluate the overall effectiveness of the project and to design future measures for Phase II implementation.

A report summarizing the additional monitoring and studies and identifying additional construction measures that could be pursued in Phase II was completed in 1998 (Nelson, et al. 1998) The recommendations from the report are summarized below:

Habitat Enhancement

- o Work with the Water Level Management Task Force to evaluate the use of pool drawdown in pool 5 as a management technique for improving conditions for aquatic vegetation.
- o Increase river - floodplain connectivity by increasing side channel flows to about one half of what they were pre-Weaver Bottoms project, either through modification or natural development.
- o Construct additional habitat islands in Weaver Bottoms.
- o Conduct backwater dredging to improve overwintering habitat for fish.

Channel Maintenance Management Plan

- o Work to find alternative placement sites for dredged material from the Sommerfield Island and Minneiska dredge cuts, possibly using the material for island construction in lower pool 5.
- o Optimize navigation channel maintenance by altering main channel hydrodynamics and sediment transport.
- o Stabilize Roebuck's Run and stabilize the shoreline of the Lost Island containment site.

Watershed/Tributary Management

- o Support for watershed management in the Whitewater River and Zumbro River watersheds to reduce sediment inputs to Weaver Bottoms.

Administrative/Monitoring

- o Continue the Weaver Bottoms Resource Analysis Program
- o Continue periodic monitoring to evaluate effects of Phase II projects.

FUTURE CONDITIONS

4.1 OVERVIEW

Planning for the future requires projecting future conditions under various scenarios, including the no action scenario. Corps of Engineers planning regulations (ER 1105-2-100) provide the following guidance concerning this subject. Future without plan conditions are the most probable conditions based on:

a) trend and existing condition information

b) available related forecasts, e.g., land use plans, population projections

c) established institutional objectives and constraints and local customs and traditions, e.g., authorized projects, refuge master plans, local recreational preferences

d) reasonably foreseeable actions of people in the absence of any proposed action

e) reasonably foreseeable natural occurrences, e.g., annual high water, natural succession

4.2 PLANNING HORIZON

A planning horizon is necessary for any planning effort. Planning horizons can range from the very short term (5 years) to the long term (100+ years). The planning horizon should be commensurate with the nature of the planning effort, the scope of the expected products of the planning effort, and the ability to predict future conditions. Channel management planning is considered a mid-range planning effort. Any projects that are implemented will likely be functional for 25 to 50 years, and possibly longer. Structural features may be relatively permanent.

A planning horizon of 50 years was selected because it provides a reasonable balance between the expected life of any recommended solutions and the ability to predict future conditions on the Mississippi River.

Consideration was given to using the 40-year planning used for the planning for long-term dredged material placement sites in the St. Paul District. This was the time frame used in the GREAT I study. There was nothing unique that led the GREAT I study team to select a 40-year planning period, a somewhat unusual time frame. It was simply a matter of convenience. GREAT I channel maintenance planners did not believe that many of the GREAT I recommendations would be implementable until 1985. They selected the year 2025 as the end year for their planning period, probably because it is the quarter century mark. There is little

relationship between this study and long-term dredged material planning, other than any measures implemented to reduce dredging requirements will extend the lifetime of existing dredged material placement sites. Therefore, using the same 40-year planning period that was used for dredged material placement planning was not considered necessary.

Because of the time required to complete this study and implement any recommended actions, and to use rounded years for easier understanding, the 50-year planning period for this study is defined as 2001 to 2050.

4.3 NAVIGATION PROJECT

As described earlier, the existing navigation project has had a significant effect on the river and its landscape. Estimating future conditions relative to fish and wildlife habitats and to recreation and other public uses of the river is highly dependent on the future of the navigation project. Therefore, it is necessary to predict in what form the navigation project is likely to exist during the period 2001-2050.

For this study, it is projected that the 9-Foot Navigation Channel project will continue to exist and function during the period 2001 - 2050 in a manner very similar to the last 60+ years. The locks and dams, supplemented by maintenance dredging, will be required to maintain a 2.7-meter navigation channel.

One change expected to occur with the project is water level management. Within the 2001-2050 time period, modifications to existing water level management to benefit fish and wildlife will likely be implemented. The exact nature of future water level management will require detailed analysis of potential benefits and negative effects. Options may range from minor adjustments to existing regulation to large scale drawdowns.

Existing conditions relative to channel maintenance are not expected to change appreciably. Measures that would have a significant effect on maintenance dredging requirements, such as reduced depth dredging and improved channel monitoring, have already been implemented. It is likely that those locations currently requiring frequent channel maintenance (such as in the Fisher Island area) would still require frequent maintenance dredging.

4.4 FISH AND WILDLIFE HABITAT

Pool 5 is part of the aging reservoir system on the Upper Mississippi River and is experiencing many of the habitat changes that are occurring throughout the system. The biological diversity and abundance of fish and wildlife, including highly valued species, have and will continue to decline as a result of the reservoir aging process. Continued operation and maintenance of the navigation system will produce further changes to the condition of floodplain and aquatic habitats.

4.4.1 PHYSICAL HABITAT CONDITIONS

Future changes in river geomorphology and hydrodynamics will greatly influence the future ecological characteristics of the Upper Mississippi River. Transport and deposition of fine and coarse sediments in an altered hydrologic regime will determine future floodplain morphology. Channel training structures have and will continue to some degree affect river flow and sediment transport.

4.4.1.1 Training Structures

Training structures affect the river at four different spatial scales. These are the local scale (e.g., near the training structure), the river reach scale (e.g., typically a 3 to 15-kilometer river reach with interdependent hydrodynamics), the navigation pool scale, and the floodplain scale (e.g., multiple pools).

The River and Harbor Acts of 1878 and 1907 authorized the development of 1.4- and 1.8-meter channels respectively. These channel depths were achieved through dredging and the construction of wing dams, closing dams, and bank revetments on the Upper Mississippi River during the late 1800's and the early 1900's. In pool 5, most of the wing dams were constructed between 1899 and 1910. The construction of training structures (wing dams, closing dams, and bank revetments) had significant impacts on the river at all four spatial scales. Locally, scour holes formed adjacent wing dam tips and near the shoreline, and sediment deposition occurred in off-channel areas, termed "safe places" in earlier documents. In many cases, these "safe places" were between wing dams where accretions resulted in the formation of "fast land." Training structures caused the number and area of islands to increase, with a concurrent decrease in the surface area of the main channel (Chen and Simons 1979). In pool 5A, Anderson et al. (1983) estimated that 45 percent of the total length of channel structures has been either buried or lost through erosion. Narrowing of the channel with control structures and sediment deposition increased low flow velocities and caused bed erosion in the main channel. The construction of closing dams along with sediment accretions in off-channel areas reduced hydrodynamic connectivity affecting river reach and floodplain scale dynamics. In a few cases, new secondary channels (e.g., Roebuck's Run) formed, increasing hydrodynamic connectivity between backwaters and the main channel.

The construction of locks and dams in the 1930's submerged most training structures, significantly changing how they affect river dynamics. On a local scale, the hydrodynamics around training structures continues to be complex. A scour hole usually developed at the tips of wing dams and at notches in closing dams. Sediment accretion occurred between wing dams and adjacent scour holes. Many training structures provide local diversity and habitat (Anderson et al. 1983 and Pitlo in Burch et al. 1984).

On a river reach scale, the effects of training structures on river planform (configuration of the channels, lakes, islands, and other features found in a river valley) were reduced to varying degrees due to inundation. Nanda and Baker (1983) report that adequate training structures, submerged 3 to 5 feet below low water surface elevation, are effective. Generally, this means that in the upper and middle reaches of pools they continue to some degree to affect reach specific hydrodynamics and sediment transport. In the lower pools, training structures are more deeply submerged and less effective. In many instances, lower pool structures are buried in sediment. Lower pool 5 may be an exception since the earth dike for dam 5 is positioned in the floodplain in such a way that river flow is forced back into the main channel. Hydrographic surveys show significant scour holes near the ends of wing dams in this reach, indicating that they are affecting channel bathymetry.

For submerged wing dams, one equation for the ratio of contracted depth to uncontracted depth was given by Anderson and Davenport (1968) as

$$Yn/Y = (Qc/Q)^{0.857} * (W/Wn)^{0.857}$$

Yn = contracted channel depth
Y = uncontracted depth
Qc = flow in the contracted section
Q = total main channel flow
W = width of main channel
Wn = width of contracted channel

For a 300 meter wide channel encroached by 100 meters of wingdams (a typical situation), a contracted section flow to main channel flow ratio (Qc/Q) of 0.67 would result in no effects of wing dams on channel depths (i.e. $Yn/Y < 1$). In other words, if wing dams are submerged enough so that about 30-percent of the total main channel flow is conveyed over them, they are ineffective.

Inundation also submerged closing dams and created new secondary channels, which increased hydrodynamic connectivity, making all training structures less effective. The two largest secondary channels in pool 5, West Newton Chute and Belvidere Slough, had closing dams constructed across their upstream ends in the 1880's. These two channels today convey 22-percent and 26-percent of the total river flow respectively. The structure at Belvidere Slough has a mean depth of only 3.1 feet for average flow conditions in pool 5. Absent a closing dam, flow

in Belvidere Slough would undoubtedly be greater; however ,this would have decreased the size of Roebuck's Run, the other large secondary channel entering this backwater. The combined discharge through Roebuck's Run and Belvidere Slough would be somewhat greater with the closing dam removed. The increased hydrodynamic connectivity affects both backwater habitat and navigation channel dredging. Based on St. Paul District data, dredge cut location is correlated more closely with secondary channel flows than with training structure density. This is the reason that the reach adjacent Weaver Bottoms requires constant maintenance dredging.

On a navigation pool and floodplain reach scale, the effects of training structures are minimal for existing river conditions. River character at these scales is dominated by manmade features such as locks and dams and agricultural or flood control levees; post glacial river valley planform; and tributary locations. Currently in pool 5, hydrodynamic connectivity (as measured by percent of total river flow in backwaters) varies from 0 to 60-percent, depending on position in the pool. The fact that hydrodynamic connectivity is greatest in the middle reach is a function of position relative to Lock and Dam 5, not on the training structures in pool 5. For example, over one-fourth of the total river flow is conveyed across the closing dam at the head of Belvidere Slough in pool 5. This structure has a mean depth of 1 meter for average flow conditions in pool 5.

During the planning horizon (2000 to 2050), and assuming no changes in pool operation or river planform, the impacts of existing training structures will continue to decrease. They will affect local bathymetry, will have varying effects on river reach specific hydrodynamics and sediment transport, but will continue to have minimal impacts on navigation pool and floodplain reach scale dynamics. With time, hydrodynamic connectivity will increase as new secondary channels form connections between the main channel and the backwaters. If pool operation is changed at some point in the future so that lower water levels occur for part of the year, the effects of training structures on pool scale and floodplain scale dynamics will increase.

4.4.1.2 Sedimentation

Sediment deposition rates found in early sediment investigation varied between 1 and 2 cm/yr (McHenry 1975, Eckblad 1977, Fremling et al. 1976). These early investigators concluded that many backwaters on the Mississippi River would be filled with sediment in 50 to 200 years. In pool 19, Bohmik et al. (1986), concluded that, by the year 2050, the river would change from a lake-like appearance to a river- and floodplain-like environment with an incised channel. However, Chen and Simons (1979), using as one of their tools a one-dimensional water and sediment routing model, predicted a river scene in the Upper Mississippi River 50 years into the future that would be essentially as it is today if no major manmade changes or natural events occur. Stage and discharge relations in the next 50 years would remain essentially as they are today. Geomorphic changes would continue following historical trends, but at a slower rate.

Recent investigations appear to support a slow change hypothesis. Korschgen et al. (1987) found an annual deposition rate of 0.2 cm/yr in Lake Onalaska for the years 1937 to 1983.

Rogalla and Boma (1996) found deposition rates (in centimeters per year) of 0.29, 0.12, and 0.80 in pools 4, 8, and 13 respectively. In Weaver Bottoms, historic deposition rates (1932-1986) are 0.18 to 0.22 cm/yr; while more recent deposition rates (1986-1991) have increased to 0.37 cm/yr (Anderson et al. 1993). Reasons for the lower deposition rates found in recent studies are related to both study protocol and physical changes in the river. Early investigations may have focused on deposition areas, while more recent investigations didn't have this bias. Physical and biological changes in the river system have also occurred. As backwater areas accrete sediment, their bed approaches dynamic equilibrium with the hydrodynamic forces affecting sediment movement, such as current velocity and wave action. Daily and seasonal differences in sediment transport affect bed elevations, but accretion rates will have been reduced to pre-colonization levels. Bohwmik et al. (1986) studied pool volume changes in pool 19 and found that the trap efficiency had decreased from 50-percent in the 1920's to 23-percent in the 1970's. In addition, reductions in plant communities may decrease sediment stability and increase hydrodynamic forces at the sediment-water interface, increasing sediment outflows. James and Barko (1990) found high levels of sediment accretion in vegetated littoral zones of Eau Galle Reservoir, Wisconsin and hypothesized that submersed aquatic plants promote sediment accumulations.

Based on the above discussion, fine sediment will continue to accumulate in backwater areas, though at reduced rates. Bathymetric diversity will decrease and fine sediment movement in backwaters will be dominated by daily variations in wind-driven wave action. Some backwaters may eventually reach a point of quasi-equilibrium between fine sediment transport and hydrodynamic forces, though the physical conditions (shallow depth, unconsolidated bottom sediments, etc.) may not be desirable. Reestablishment of aquatic vegetation could change backwater sediment movement so that it follows a seasonal time scale in sync with flood events. Increased vegetation growth would trap sediment during the growing season, some of which would be removed by wave resuspension and advective transport during fall and spring high water events when vegetation is dormant. The loss of bathymetric, biologic, and subsequently hydrodynamic diversity in backwater areas will limit future dynamic changes in backwater areas. Instead of erosion and deposition zones, corresponding to local bathymetry or plant beds, flow now spreads out across backwaters depositing sediment but lacking the energy to scour sediment.

Coarse sediment transport potential varies longitudinally with the upstream reach of the pool having a high transport potential, the downstream reach having a low transport potential, and the middle reach being a transition between the two regimes. Coarse sediments are transported through the upper reach to the middle reach where shoaling occurs due to the decreased transport potential. Dredging occurs mainly in the middle transition reach, causing a reduction in sediment available to the lower reach. So even though sediment transport potential is lowest in the downstream reach, the sediment load has also been reduced, resulting in minimal channel dredging. Within the main channel, both island erosion and formation occurs, though erosion is the dominant process. In a few reaches of the Mississippi River, coarse sediment transport and hydrodynamic conditions are conducive to island formation. In pool 6, which has the lowest hydrodynamic connectivity, and is probably closest to dynamic equilibrium of any pool in the St. Paul District, island formation and loss is occurring. Jefferson (1995) observed new islands

being formed and older islands eroding away in pool 6. This process is not occurring in pool 5 yet.

The trend during the 60-years since inundation has been for increased hydrodynamic connectivity as the number and size of secondary channels increased. This trend will continue through the planning horizon used for the pool 5 study as secondary channels continue to erode. Beyond the planning horizon, continued backwater delta expansion, and colonization of deltas by terrestrial plants, backwater flow resistance eventually will increase, resulting in steeper water surface slopes, deeper channels, increased discharge in the navigation channel; and increased transport of sand into lower pool reaches. Coarse sediment transport to Belvidere Slough may result in characteristics similar to those found in pool 6. The downstream movement of sand may be limited by channel dredging, however, coarse sediment will accumulate in the lower pools resulting in deltaic island growth in these areas sometime in the distant future.

Like most pools, the lower part of pool 5 has experienced the loss of islands, especially in the Spring Lake area. The loss of islands in the lower part of pool 5 has not been as extensive as some of the other pools on the Upper Mississippi River. Much of the floodplain near lock and dam 5 is included in pool 5A by the lock and dam 5 dike, which extends approximately 3 kilometers upstream from lock and dam 5. This has greatly reduced the amount of large open lake area, with sparse low-lying islands, above the dam. There likely will be a continued "leveling" of the pool bottom by wave action and currents. At present no areas in Lost Island Lake have shown island emergence. However, delta formation in the area of Lost Island Lake and downstream may eventually offset and restore some of these islands, although this may occur far into the future. The Spring Lake HREP is focusing on restoration some of the islands in the Spring Lake area.

Pool 5 receives an extensive amount of bed material load from pool 4 because of the Chippewa River. The Zumbro River and Whitewater River add large quantities of wash load and some bed material load. In the stretch from lower pool 4 to 8 studied by GREAT I (1980), pool 5 ranked second highest in the amount of bed material load and wash load of sediments inflowing into the pool. The ecological characteristics of pool 5 have and will continue to be greatly influenced by the extensive amount of total sediment load entering pool 5. Declines in bathymetric diversity have occurred and will continue to occur over the next 50 years.

The Weaver Bottoms, another backwater lake in this area of the pool, has had significant changes in hydrodynamic conditions, as part of effort to manage this riverine lake. The future of Weaver Bottoms, will depend on decisions reached on how this area is to be managed.

4.4.2 WATER QUALITY

Water quality in pool 5 is greatly influenced by the inputs from Zumbro and Whitewater Rivers bringing agricultural chemicals and suspended sediments into the system. The channelization of the lower Zumbro River and portions of the Whitewater River prevents

sediments from settling in the floodplain and deltas of these rivers, resulting in most of the sediment loads being carried directly into the Upper Mississippi River. Recent efforts to improve watershed management in the basins of these rivers may eventually reduce sediment loading to the Upper Mississippi River. However, heavy inputs of sediments from these tributaries are likely to continue during the 50-year planning period. Recent proposals to restore the connectivity of these rivers with their respective floodplains and deltas could significantly reduce the amount of sediment loadings to the Upper Mississippi River, although floodplain areas like the McCarthy Lake State Wildlife Area could experience significant increases in sediment loads.

Backwaters in the upper region of pool 5 will continue to shrink in size and become less interconnected with the main river under lower river discharge conditions. These areas could experience greater problems with oxygen depletion, similar to pre-inundation conditions.

Suspended solids and total inorganic nitrogen in pool 5 have generally increased since the drought conditions in the late 1980's (Sullivan 1996). The decline in aquatic plants in pool 5 resulting from the drought conditions may explain part of the increases in suspended solids. Aquatic plants dampen the disturbance of bottom sediments reducing resupension of sediments from waves and current. Elevated suspended solids are likely to continue to occur in pool 5 until improvements are seen in the aquatic plant community, which may not occur within the 50-year planning horizon.

4.4.3 PLANT COMMUNITY

In an unregulated river, water level fluctuations create gradients of soil moisture, which range from complete drowning of plants during high water conditions, to desiccation during periods of low water (Nilsson 1996). These conditions create obvious zones of riparian and aquatic vegetation. These zones fluctuate with episodic events (floods and droughts) and with changes in long-term regional climatic conditions (wet and dry cycles). Low water levels associated with summer and winter low river discharges and periodic droughts have not occurred on the Upper Mississippi River since construction of the locks and dams, because minimum project pool elevations are maintained for navigation. This restriction on water levels affects soil moisture gradients and subsequent vegetation zonation. In addition, channelization has reduced the extent of floodplain reconfiguration.

As a result of lock and dam construction, total terrestrial habitat within pool 5 (measured from 1929 to 1973) was reduced from 86 percent to 58 percent of the floodplain (Olson and Meyer 1976). The greatest loss was in upland/wetland meadow habitat, which was reduced from 23 percent to 15 percent of the floodplain. Approximately 20 percent of the bottomland forest in pool 5 was lost, from clearing during the navigation project construction and inundation of terrestrial habitats. The floodplain vegetation on the Upper Mississippi River has been continuously adapting to these changed conditions since construction of the navigation dams. Within the 50-year planning horizon, a substantial increase in terrestrial habitat is not likely to occur. However, the general long-term projection for the future is that as backwaters fill in with

sediments, there will be a restoration of terrestrial habitat, mainly meadows and floodplain forest.

The aquatic plant community exploded following inundation of large fertile floodplain areas by the locks and dams. However, because of stable water levels, loss of protective islands and bathymetric diversity, wave and current action, and other factors, the aquatic plant community has declined. Since significant changes in river bed morphology and hydrodynamics are not projected to occur within the 50-year planning horizon, the aquatic plant community is likely to continue in a suppressed mode. Episodic events like the regional drought conditions of the late 1980's caused a temporary partial restoration of the aquatic plant community, followed by a precipitous decline because of a combination of factors having to do with underwater light penetration and availability of plant nutrients in sediments. Emergent vegetation has not shown a great recovery from the late 1980's drought. Submerged vegetation has rebounded in certain areas, but in some cases predominately by the exotic Eurasian milfoil (*Myrophyllum spicatum)* (Rogers 1994). In the Weaver Bottoms backwater in pool 5, wind and wave action is a major factor in sediment resupension and light availability for plants. Wind and wave action may also be a major factor in sediment nutrient availability. In an alluvial marsh, Mitsch et al. (1979) found that input of phosphorus, by nutrient rich sediments during the annual flood, was eighteen times greater than all other inputs during the year, with less than 10 percent being reexported to the main river over the annual cycle. In Weaver Bottoms part of the wave resuspended sediments is being exported out of Weaver, reducing sediment nutrient availability. In addition, resupension of the nutrient rich sediments by wave action may be increasing the availability of water column nutrients. Increasing water column nutrients would encourage algae production, further affecting light availability for aquatic macrophytes.

In the future, the aquatic plant community will likely continue to experience reduced or continued declines in productivity. Beyond the planning horizon as the slack water areas continue to fill with sediments, aquatic plant coverage will slowly expand. However, as sedimentation continues, much of the slack water aquatic areas will be converted to terrestrial habitat, mainly wetland meadows and floodplain forest.

4.4.4 FISH AND WILDLIFE COMMUNITY

Prior to construction of the 9-foot channel project, the fishery of the pool 5 area was largely dominated by riverine species adapted to a lotic, or flowing water environment. With construction of the project and creation of slow moving "backwater" and pool habitat, like Weaver Bottoms, a shift in the fishery occurred. Lentic species, notably members of the Centrarchid family, increased in abundance. With the inundation, there was an overall increase in total fish biomass proportional to the amount of new water area. The habitat quality for lentic species has declined in recent years, because of the losses in the aquatic plant community and continued shrinking and isolation of aquatic areas in the upper reaches of the pool. The aging of the reservoirs created by the locks and dams will undoubtedly affect the composition of the future fishery. Habitat quality for lentic species is likely to continue to decline within the 50-year planning horizon. Eventually as the middle and lower reaches continue to agrade, habitat quality

for lentic species would improve. However, as backwaters continue to slowly fill with sediment, habitat for species adapted to lentic conditions will decline in favor of more lotic species. As aquatic areas are converted to terrestrial habitat there will be a subsequent loss in total fish biomass.

The freshwater mussel resources of the Upper Mississippi River have been greatly impacted by development in the river basin. Qualitatively new conditions for mussels were created by the 9-foot channel project's impoundment of significant stretches of the Upper Mississippi River (Fuller 1980). This introduced new problems for mussel, notably reduction of the movements of fishes that host parasitic mussel larvae and acceleration of sediment accumulation. Additionally, the accelerated sediment accumulation required maintenance dredging to maintain the channel which can directly affect mussels. Freshwater mussels in pool 5 are somewhat limited because of the extensive amount of sediment loads coming into the pool. However, relatively diverse, abundant mussel assemblages can be found in areas with more stable substrate conditions. Because mussels are not as wide spread, as is the case in the lower pools within the St. Paul District, these pockets of good mussel populations are important to maintaining the mussel assemblage in pool 5. The sediment loads to pool 5 are projected to continue at high levels, restricting freshwater mussels in pool 5. The ultimate future of freshwater mussels on the Upper Mississippi River, including pool 5, is going to be highly dependent on the ability of freshwater mussels to withstand or recover from the onslaught of the colonization of the Upper Mississippi River by the exotic zebra mussel.

The impact of sediment transport to backwater areas depends on the local landscape. In small backwaters, more typical of upper pool reaches, coarse sediment transport is usually viewed as negative. The general reduction in water depths and size of these small backwaters, in combination with reductions in water circulation, tends to reduce the value of these areas for desired species of fish and wildlife. In large backwaters more typical of mid and lower pool reaches, coarse sediment transport results in deltaic formations at the terminus of secondary channels. These areas are biologically productive and thus very desirable for certain species of wildlife. However, the marsh and shallow aquatic areas that are filled by delta expansion are also productive for other species of wildlife. This process will continue in backwaters, however, recent efforts to reduce hydrodynamic connectivity may reduce the rate of delta expansion.

Wildlife use of the pool 5 floodplain will continue to change as the physical habitat conditions in pool 5 change. Waterfowl use of pool 5 has declined because of the declining aquatic vegetation and will continue to be below historic use levels until the vegetative community shows greater recovery. Other species of birds and aquatic mammals that depend on a healthy marsh have also declined in pool 5. Within the 50-year planning horizon, this trend in declining use by marsh species is likely to continue. Eventually, beyond the 50-year planning horizon, as the backwaters fill in and more marsh and shallow aquatic habitat is created, use by waterfowl and other species of marsh wildlife will increase.

4.5 RECREATION AND PUBLIC USE

The primary change to recreation and public use in lower pool 5 during the period 2001-2050 will be the increased demands associated with population growth. The focus of recreation activities will still be the river and associated floodplain habitats. The primary recreational activities are not expected to change significantly from those that are popular today, e.g., fishing, hunting, trapping, boating, camping, swimming, and picnicking. Shallower depths throughout the river floodplain due to the systemic impacts of impoundment (sedimentation) may necessitate the use of shallower draft boats on the river.

Many forms of recreation common to the river require facilities such as boat ramps, trails, campgrounds, beaches, picnic areas, etc. The public demand for these facilities is going to grow and steps will be required to meet these demands.

Recreational use of the Upper Mississippi River is directly related to habitat quality, especially for such activities as hunting, fishing, and trapping. Declines in future habitat quality would likely result in a decline in opportunities for these forms of recreation.

PROBLEM IDENTIFICATION

5.1 CHANNEL MAINTENANCE/NAVIGATION

Table 5-1 summarizes information concerning existing dredge cuts in pool 5. As can be seen from the table, most of the dredging in pool 5 occurs in a 11-kilometer reach in the middle of the pool between river miles 742.6 and 749.6. About 9.5 kilometers of this 11-kilometer reach are classified as dredge cut. Average annual dredging volume in the pool is about 88,000 cubic meters. Site specific channel maintenance and navigation problems are discussed below.

Table 5-1
Pool 5 Dredge Cuts (1970-98)

Cut	River Miles	Percentage Years Dredged	Ave Vol/ Job (m^3)	Ave Vol/ Year (m^3)
L. Approach to L/D 4	752.6 - 752.7	10	4,000	400
Mule Bend	748.6 - 749.6	38	25,700	9,700
West Newton	747.2 - 748.2	31	16,100	5,000
Below West Newton	746.0 - 746.8	59	22,100	12,900
Fisher Island	744.8 - 746.0	72	34,000	24,600
Lower Zumbro	744.0 - 744.6	52	29,300	15,100
Minneiska	742.6 - 743.9	31	18,200	18,200
Above Mt. Vernon Light	741.2 - 741.5	7	30,600	2,100
				88,000

source: Channel Maintenance Management Plan (April 99)

Dredging requirements in pool 5 are a function of the sediment transport and hydrodynamic regimes in the pool. A significant amount of sand enters pool 5 from pool 4 and the Zumbro River. At secondary channels, the loss of water to the backwaters reduces the sediment transport potential of the navigation channel, resulting in a shoal and subsequent channel maintenance dredging. Sediment transport potential is also low in the lower portion of the pool because water is spread out over a large area.

When the Weaver Bottoms project was constructed, the sediment transport potential of the navigation channel adjacent to Weaver Bottoms was increased. This reduced dredging at some of the historic dredge cuts noted in table 5-1, but increased it downstream at the Minneiska and Above Mt. Vernon Light cuts.

5.1.1 HEAD OF BELVIDERE SLOUGH

Belvidere Slough is a major secondary channel that carries about 25 percent of the river's discharge. The head of Belvidere Slough is on the outside of a river bend and monitoring of the navigation channel in this area indicates that the channel is shifting into the head of Belvidere Slough. If left unchecked, this could make this bend increasingly difficult to navigate by commercial barge tows.

5.1.2 ROEBUCK'S RUN AREA

At river mile 746.6 Roebuck's Run, a short side channel conveying about 20 percent of the river's flow, branches off to the left. A bend in the main channel, complicated by the loss of main channel flow, results in shoal formation and a high frequency dredging requirement. In addition, the flow into Roebuck's Run causes an outdraft affecting navigation.

5.1.3 MINNEISKA

Sediment accumulation has increased significantly in the bend at Minneiska (river mile 742.5) and below since construction of the Weaver Bottoms project. The deposition of sand in this reach makes channel maintenance less efficient due to the increased transport distances to designated placement sites. The narrowing channel in this location causes maneuvering difficulty for tows. During the period 1975-1989, no dredging was required in this reach. During the period 1990-1998 dredging was required in 7 of the 9 years.

In 1997 the MN-14 outlet from Weaver Bottoms was modified. This should improve maneuverability in the bend by reducing velocity and improving the angle of flow. It may or may not have a beneficial effect on the point bar and dredging requirements. Additional measures may be necessary to improve safety at this bend.

5.1.4 ABOVE MT. VERNON LIGHT

Historically, dredging took place at the Above Mt. Vernon Light cut at river miles 741.2-741.5. Until 1996, dredging had not been required at this site for twenty years. Renewed dredging requirements at this site are believed to be related to the Weaver Bottoms project.

5.2 FISH AND WILDLIFE HABITAT

Fish and wildlife habitat problems in pool 5 were identified in coordination with river resource management agencies and the public. Habitat problems can range from the systemic to the site specific. What is considered a habitat problem can depend on individual perspective and/or the public and personal values placed on the species using the habitat. In some instances, what is viewed as a site specific problem may actually be a reflection of a long term systemic change.

5.2.1 ISLAND 40/WIGGLE WAGGLE SLOUGH

Island 40 is located immediately downstream of Lock and Dam 4. For a number of years the head of Island 40 has been eroding, changing flow and sedimentation patterns in Wiggle Waggle Slough which runs behind the island. State natural resource agencies have indicated that these changes to Wiggle Waggle Slough are characteristic of the natural dynamics of a river system and do not constitute a particular habitat problem.

Island 40, because of its location adjacent to the Lock and Dam 4 tailwaters is used by perching bald eagles, especially the large trees along the shoreline. Open water areas in the winter such as dam tailwaters are popular feeding areas for bald eagles. The erosion of Island 40 is resulting in the loss of large perching trees, particularly cottonwoods.

5.2.2 ZUMBRO RIVER

Historically, flow from the Zumbro River divided into 27 kilometers of meandering north and southbound channels before entering the Mississippi River. Around 1914, a channel was dredged through a high sand prairie to divert the Zumbro River from its distributaries directly into the Mississippi River. In the 1950's, local levees were constructed after the 1951 flood. Prior to 1972, however, the Zumbro River reoccupied its old channels during floods larger than the 6-year flood and deposited sediments over many hectares of floodplain.

The 1965 Flood Control Act authorized modification of the Zumbro River below Kellogg, Minnesota to alleviate damages to adjacent rural areas from flooding. The project plan provided for approximately 4,850 meters of continuous channel modification, including two channel cutoffs, a system of continuous setback levees totaling about 7,160 meters paralleling both banks of the river, and slope protection of riverbanks susceptible to bank erosion. Earlier levees constructed by local interests were incorporated into the project design. Construction of the project was completed in 1974. The project isolated the Zumbro River from its floodplain in this reach for up to the 50-year flood event.

Prior to the Zumbro River Flood Control Project, large Mississippi River flood events used the lower Zumbro River floodplain for flood conveyance. During floods, the Zumbro River Flood Control Project blocks Mississippi River advective flow from moving across the

floodplain, raising Mississippi River flood stages upstream.

Reintegration of the Zumbro River's distributary channels with their floodplain would restore the dynamic processes of erosion and deposition which sustained a complex mosaic of aquatic and terrestrial habitats prior to interruption by recent human activities. Flowing channels would be recreated, seasonal and permanent wetlands would develop, and flowage between pools 4 and 5 would connect these two river reaches. Floodplain forest would regenerate over time and prairie restoration could be accomplished on river terraces.

The Zumbro River's sediment contribution to the Mississippi River would be reduced which could result in a reduction in maintenance dredging for the navigation channel. However, a significant percentage of the Zumbro River would have to be restored to historic channels to affect the amount of dredging done in pool 5.

5.2.3 MOSIMAN'S SLOUGH BACKWATERS

Mosiman's Slough and its associated backwaters are located on the Wisconsin side of the main channel between river miles 748 and 750. This area has historically provided high quality habitat for backwater fish species, especially during the winter. Flow and sedimentation patterns in Mosiman's Slough appear to be changing, which may eventually result in a decline in the value of this area as overwintering habitat for fish. Sand sedimentation has already occluded some the mouths of sloughs in this area, increasing the potential for fish to become trapped during the winter when ice formation closes off these shallow areas.

5.2.4 PROBST LAKE

Probst Lake is a backwater lake located in the interior of Island 46. Probst Lake has historically provided high quality overwintering habitat for fish. Local citizens have indicated that this lake is one of the highest quality panfish waters remaining in pool 5. A small breach has occurred in the island between Probst Lake and Belvidere Slough. Expansion of this breach could reduce the value of the lake as overwintering habitat. Sand is already being deposited in the upper end of Probst Lake from this breach.

5.2.5 WILLOWCAT SLOUGH

Sedimentation is resulting in the formation of a plug at the head of a Willowcat Slough on the right bank at river mile 748.3. If this continues, the slough may change from a running slough to an isolated backwater habitat.

5.2.6 KRUEGER SLOUGH

Sedimentation is resulting in the formation of a plug at the head of Krueger Slough at river mile 746.9. If this continues, the slough may change from a running slough to an isolated

backwater habitat.

5.2.7 WEAVER BOTTOMS

The fish and wildlife habitat problems and ongoing efforts at habitat restoration were addressed earlier in Section 3.4.

5.2.8 SPRING LAKE

In 1994, a breach in the barrier island chain at the upper end of Spring Lake was repaired for the purpose of reducing flows and sediment entering the lake. This work was completed under the UMRS-EMP habitat rehabilitation and enhancement projects program.

Many of the islands in lower Spring Lake have been lost to erosion, resulting in a reduction in habitat diversity. In addition, the loss of the islands has exposed Spring Lake to increased wind fetch, increasing wave induced turbidity. The increased turbidity and physical effects of waves make conditions less suitable for the growth of aquatic plants.

5.2.9 LOWER BELVIDERE SLOUGH

At its lower end, between Spring Lake and the main channel, Belvidere Slough widens into a broad shallow area with a shifting sand bottom. This area is devoid of islands and habitat quality is considered low to moderate. Measures to create land and/or more bathymetric diversity would improve habitat quality in this area.

5.2.10 LOST ISLAND LAKE

Sand is entering Lost Island Lake and changing its character. Its value as habitat for backwater fish species such as bluegill and crappie is declining. At one time, the backwater fishery in portions of the Lost Island Lake complex rivaled that of Probst Lake in quality. This change in character is viewed negatively by the public because of the declining fishery.

Lost Island Lake receives water from two sources, the Mississippi River main channel and Belvidere Slough. Suspended sediment concentrations are lower in Belvidere Slough than in the main channel. For 1975-86 conditions, water flowing into Lost Island Lake from the two sources amounted to 6.3 percent from the Mississippi River and 4.3 percent from Belvidere Slough. For 1987-95, these percentages changed to 9.1 and 4.8, respectively. Thus, not only has the total discharge to Lost Island Lake increased, but most of this increase was from the Mississippi River main channel.

5.2.11 LOWER POOL 5 WING DAMS

In lower pool 5 from Lock and Dam 5 upstream to about river mile 740.5, the river is

constrained between the Minnesota mainland and the Lock and Dam dike. Using the criteria of fishing success, local citizens have indicated that the wing dams on the Wisconsin side of the navigation channel appear to provide better fishery habitat than those on the Minnesota side of the channel. The opportunity may exist to improve habitat diversity with wing dam modifications or with the addition of features to promote island formation.

5.2.12 FISH PASSAGE

All of the locks and dams impede fish migration to some degree. Because of its operating characteristics, Lock and Dam 5 is considered the largest barrier to fish migration in the pool 4 through pool 10 reach of the St. Paul District. It is believed that most fish passage upstream through the navigation dams occurs when the gates are lifted from the water during high flow conditions. The gates are lifted from the water at Lock and Dam 5 at less frequency and for less duration than at other locks and dams because of its operating characteristics.

5.3 RECREATION

Declines in fish and wildlife habitat as discussed above have an effect on recreation, as declines in habitat quality adversely affect hunting, fishing, trapping, and non-consumptive fish and wildlife activities. Other recreation problems identified by the public relative to this study have focused on recreational boat access. The primary culprit in pool 5 is sand bar formation that either blocks recreational boat access to a desired area, creates inconvenience by forcing the use of alternate routes, or is a hazard because of groundings.

There is a lot of sand passing into and through Belvidere Slough. This results in considerable sand shoaling which can make recreational boat passage in this area difficult for those not familiar with the locations of shoals and how they can change with changing flow conditions.

A number of specific areas have been identified by the public where sand bar formation makes recreational boat access/passage difficult or in some instances, impossible. They are:

- entrance to Mosiman's Slough complex (RM 748.8 left bank)
- side channel opening below Mosiman's Slough (RM 748.4 left bank)
- side channel opening above Mule Bend (RM 748.4 right bank)
- entrance to channel leading to Half Moon Landing
- entrance to Murphys' Cut (RM 747.4 right bank)
- lower end of Sand Run where it enters Belvidere Slough
- portions of Lost Island Lake
- upstream entrance to Spring Lake known as the "S-turn" entrance

PROJECT GOALS AND OBJECTIVES

Goals and objectives for a resource such as the Upper Mississippi River can vary greatly depending upon perspective. Federal and State agencies have mandates and missions that require them to focus on particular aspects or uses of the resource. The public and users of the river all have their perspective on what the river should look like, and what functions or uses should receive priority for management.

It was recognized early in the study process that for a dynamic resource of the magnitude of the Mississippi River two types of goals are required, long-term and short-term. Long-term goals are more visionary and could be characterized as answering the question "What should the river look like 100 or 200 years from now?" Short-term goals address the planning horizon, i.e., the period 2001-2050. As a rule, short term goals should support the long-term goals, or at the very least, not make accomplishment of long-term goals more difficult.

6.1 PROBLEMS/ISSUES OUTSIDE THE SCOPE OF STUDY

A number of resource problems and their causes have been identified for the study area, as noted in the previous section. Some of these problems are beyond the practical scope of this study effort to develop and implement solutions. In some instances the problems are being addressed as part of other studies. The more significant of these are discussed below. No goals and objectives were developed for problems/issues considered outside the scope of this study.

6.1.1 WATER LEVEL MANAGEMENT

Modification of the current method of navigation pool regulation has the potential to provide significant environmental benefits. However, evaluation of water level management alternatives is beyond the scope of this study. It is unknown to what degree water level management modifications may be implemented in pool 5 over the next 50 years.

As noted earlier in this report, a water level management study has been completed, recommending implementation of a pilot drawdown in pool 8 in 2000. The drawdown study evaluated a variety of drawdown alternatives. The results of that study were taken into consideration during this study. The functioning of existing and modified channel structures under drawdown conditions were considered during the evaluation of potential modifications.

6.1.2 FISH PASSAGE

As noted earlier, Lock and Dam 5 is considered the largest impediment to fish passage of any of the navigation dams within the St. Paul District below Lake Pepin. A study under the Long Term Resources Monitoring program is investigating existing opportunities for fish passage and the potential general effects on fish movement amongst the navigation pools. A status report on this effort (October 1996) concludes that "...the study does support the view that locks and dams do adversely affect fish movement."

The study, design, and construction of a fish passage structure at Lock and Dam 5 (including the earthen dike) would require a specialized study with a depth of analysis and evaluation considered by the St. Paul District as beyond the scope of the District's Channel Management Program.

There are other avenues available for evaluation of this issue. A proposal for installation of a fish passage structure at Lock and Dam 5 was submitted for consideration under the UMRS-EMP habitat projects program. Unfortunately, this proposal has never received the priority consideration that would allow it to be evaluated under the current authorized life of the UMRS-EMP (the year 2002). Should the UMRS-EMP (or a similar program) be reauthorized beyond that date, it is possible that this proposal would rise sufficiently in priority to be implemented.

Installation of a fish passage structure at Lock and Dam 5 could be pursued under Section 1135 authority. Study under this authority would require a non-Federal sponsor to cost share in the study and implementation of the project (see paragraph 1.6.1).

Further evaluation and installation of a fish passage structure at Lock and Dam 5 could also be pursued under operation and maintenance authorities. Funding for study and implementation would have to be through the Corps of Engineers operation and maintenance budget process. At this time the St. Paul District does not feel that there is sufficient information concerning the effects of Lock and Dam 5 (or any other locks and dams within the District) as a barrier to fish passage and the subsequent effects on fish populations to determine if or what additional studies are warranted. Thus, budget requests for a study of this magnitude are not being pursued in lieu of other priorities such as water level management. As priorities change in the future and additional knowledge is developed on the effects on fish populations of the locks and dams, budget requests may be pursued for this kind of study/project.

6.1.3 WEAVER BOTTOMS

As discussed in previous sections of this report, habitat problems in Weaver Bottoms have been addressed by previous investigations and are the subject of an ongoing evaluation by the Weaver Bottoms Task Force. Because of this ongoing effort, further study of Weaver Bottoms under the Channel Management Program is considered unnecessary.

The final evaluation report of the Weaver Bottoms Task Force for Weaver Bottoms was completed in 1998. The Task Force recommendations were taken into account and integrated into this planning effort.

6.1.4 SPRING LAKE

As discussed previously in this report, the habitat problems in Spring Lake are being addressed under the habitat rehabilitation and enhancement project program of the UMRS-EMP. Therefore, investigations pertaining to Spring Lake under the Channel Management Program are considered unnecessary.

6.2 UPPER MISSISSIPPI RIVER SUMMIT VISION

As noted earlier, identification of goals for the Mississippi River is not an easy task. Until very recently, it is unlikely that any systemic goal existed that was agreed to by a majority of Federal and State agencies, river users, and the public. However, in February 1996 the Upper Mississippi River Summit meeting was held, convening representatives of Federal and State agencies and river user groups to discuss a multi-interest strategy for managing the natural resources of the river. Most of the representatives attending that meeting agreed to a vision statement for the Upper Mississippi River as follows:

"To seek long-term compatibility of the economic use and ecological integrity of the Upper Mississippi River"

This vision statement has been expanded upon for this study to form the following long-term goal.

"Maintain, enhance, or restore the Mississippi River as a quality riverine ecosystem for all uses of the system, including fish and wildlife, commercial navigation, recreation, and riparian uses so that sustainable multiple use is achieved."

6.3 GOALS

The following goals were developed for the selected 50-year planning period in coordination with river resource management agencies. The goals are categorized by their primary functional area.

6.3.1 CHANNEL MAINTENANCE/NAVIGATION

6.3.1.1 Channel Maintenance/Navigation Goal #1: Reduce channel maintenance dredging requirements in pool 5.

The basis for this goal is twofold. First, channel maintenance dredging costs money, and the Corps of Engineers, as managers of the 9-foot navigation channel project, have an obligation and responsibility to manage the project in as cost effective manner as possible. Secondly, channel maintenance dredging has environmental effects, primarily associated with the placement of the dredged material. Reducing dredging requirements will reduce the environmental effects associated with dredging and dredged material placement.

6.3.1.2 Channel Maintenance/Navigation Goal #2: Reduce the cost and environmental effects of channel maintenance dredging in pool 5.

Total elimination of channel maintenance dredging in pool 5 is not possible. Therefore, the goal is to accomplish required dredging in a manner that minimizes both costs and adverse environmental effects. One potential measure of accomplishing reductions in costs and environmental effects is to increase beneficial use of dredged material.

6.3.1.3 Channel Maintenance/Navigation Goal #3: Reduce or eliminate navigation safety hazards in pool 5.

The navigation channel in pool 5 contains some difficult bends for commercial barge traffic to negotiate. In addition, there are some locations in the pool where outdrafts affect the navigability of the channel. Reducing or eliminating these hazards would reduce the potential for accidents and the associated potential for loss of life, property, and environmental degradation.

6.3.2 ENVIRONMENTAL

6.3.2.1 Environmental Goal #1: Restore and enhance natural river processes.

As noted earlier, the broad fish and wildlife habitat "problem" in the study reach is the continued loss of habitat diversity. This is considered by the scientific community to be largely the result of the disruption of the annual hydrograph and the disruption of the hydraulic processes associated with unimpounded/unconstrained river. Restoring, maintaining or enhancing these natural river processes should result in improved habitat conditions.

6.3.2.2 Environmental Goal #2: Restore and enhance habitat quality and diversity within the study area.

This goal is an extension of the previous goal. In many instances, the impoundment of the river by locks and dams and channel structures required for maintenance of the navigation channel may not allow the restoration of natural river processes as fully as desired. Other measures may be required to restore habitat quality and diversity in pool 5.

6.3.3 RECREATION

6.3.3.1 Recreation Goal #1: To protect, maintain and possibly enhance recreational beaches within the study area.

There are a number of popular recreation beach sites within the study area. Management actions should protect and/or enhance existing beach sites and the water access to them.

6.3.3.2 Recreation Goal #2: To sustain existing access routes to recreational boat landings.

There are eleven boat landings within the study area. Management actions will not include dredging boat accesses; however, recommended management actions should not jeopardize existing water depths at the landings.

6.4 OBJECTIVES

Objectives are more specific than goals. They are designed to provide the link between specific problems and the broader goals. Study recommendations usually address objectives and contribute toward meeting goals. The objectives are also categorized by their primary functional area. As with any multiple-use planning effort, it is recognized that there may not be 100 percent compatibility of the objectives across functional areas.

6.4.1 CHANNEL MAINTENANCE/NAVIGATION

6.4.1.1 Channel Maintenance/Navigation Objective #1: Reduce dredging requirements in pool 5.

Because of the sediment transport and hydrodynamic regimes in pool 5, it may be difficult to reduce the total amount of dredging in pool 5. However, any reductions that can be achieved would be beneficial in reducing channel maintenance costs and extending the life of designated dredged material placement sites.

6.4.1.2 Channel Maintenance/Navigation Objective #2: Optimize dredging locations in pool 5.

The Weaver Bottoms project is having the effect of shifting dredging requirements toward lower pool 5, away from designated dredged material placement sites, increasing channel maintenance costs. It may be desirable to shift dredging requirements back upstream closer to the designated placement sites (possibly by increasing flow to Weaver Bottoms), or shift them further downstream in pool 5 if a beneficial use of the dredged material (such as island construction) can be identified.

6.4.1.3 Channel Maintenance/Navigation Objective #3: Reduce or eliminate the outdraft problem at Roebuck's Run.

The objective is to remove the potential hazard to navigation presented by an outdraft that occurs at the mouth of Roebuck's Run. This will have to be considered in conjunction with objective #2 as measures to reduce the outdraft are likely to have an effect on dredging requirements elsewhere in the pool.

6.4.1.4 Channel Maintenance/Navigation Objective #4: Reduce or eliminate the navigation maneuverability problem at the Minneiska bend.

The objective is to remove the potential hazard to navigation presented by the bend at Minneiska. This will have to be considered in conjunction with objective #2 as measures to reduce this hazard may have an effect on dredging requirements elsewhere in the pool.

6.4.2 ENVIRONMENTAL

Some of the environmental objectives are broadly defined and can be applied to the entire study area. Others are targeted toward specific areas of high resource value and concern.

6.4.2.1 Environmental Objective #1: Remove or modify channel control structures (wingdams, old shoreline revetment/protection, closing dams) which are no longer functional or needed for maintenance of the 2.7-meter navigation channel, and whose modification would substantially rejuvenate the scouring and depositional forces of the river.

Channel control structures are designed to concentrate flow in the navigation channel for the purpose of maintaining depths sufficient for commercial navigation. By their very nature, they are designed to control the natural fluvial processes of the river. All of the structures in pool 5 were constructed prior to the 9-Foot Navigation Channel Project. Due to the passage of time many have deteriorated. Modification or removal of these structures could contribute to improvements in habitat quality and diversity.

6.4.2.2 Environmental Objective #2: Maintain bald eagle perching habitat below Lock and Dam 4, in particular on Island 40.

Bald eagles overwintering on the Upper Mississippi River require open water areas as feeding sites. The Lock and Dam 4 tailwaters are one such site. Bald eagles use large trees adjacent to the river as perching sites. Island 40 is particularly valuable for eagle perching because of its location adjacent to the tailwaters and relative isolation from human activity. Alternative perching areas are not readily available because the city of Alma, Wisconsin, occupies the entire Wisconsin shoreline. The shoreline along the right bank of Wiggle Waggle Slough is somewhat distant from the tailwaters and offers less suitable perching sites because of this.

6.4.2.3 Environmental Objective #3: Reintegrate the Zumbro River distributary channel system with the river's floodplain.

Reintegration of the Zumbro River's distributary channels with their floodplain would restore the dynamic processes of erosion and deposition which sustained a complex mosaic of aquatic and terrestrial habitats prior to interruption by recent human activities. Flowing channels would be recreated, seasonal and permanent wetlands would develop, and flowage between pools 4 and 5 would connect these two river reaches. Floodplain forest would regenerate over time and prairie restoration could be accomplished on river terraces.

6.4.2.4 Environmental Objective #4: Prevent the degradation of the Mosiman's Slough backwater area as a high quality overwintering area for fish.

The Mosiman's Slough backwater area has historically provided high quality overwintering

habitat for fish. Overwintering habitat is generally considered one of the limiting factors on the fishery resources of the Upper Mississippi River. Therefore, it is important to prevent the further degradation of this type of habitat

6.4.2.5 Environmental Objective #5: Prevent the degradation of Probst Lake as a high quality overwintering area for fish.

Probst Lake has historically provided high quality overwintering habitat for fish. Overwintering habitat is generally considered one of the limiting factors on the fishery resources of the Upper Mississippi River. Therefore, it is important to prevent the further degradation of this type of habitat

6.4.2.6 Environmental Objective #6: Maintain Willowcat Slough as a running slough.

Sedimentation is resulting in the formation of a plug at the head of Willowcat Slough on the right bank at river mile 748.3. If this continues, the slough may change from a running slough to isolated backwater habitat. Channel structures in the area may be contributing to this change.

6.4.2.7 Environmental Objective #7: Maintain Krueger Slough as a running slough.

Sedimentation is resulting in the formation of a plug at the head of Krueger Slough at river mile 746.9 and is also occurring in the lower reaches of Krueger Slough. If this continues, the slough may change from a running slough to isolated backwater habitat. Channel structures in the area may be contributing to this change.

6.4.2.8 Environmental Objective #8: Reduce the rate of sand sedimentation in the Lost Island Lake.

Lost Island Lake has historically been a highly productive backwater fishery. Its value as such has been declining due to sand sedimentation. While this may be a natural change due to riverine processes, the public has indicated that they would prefer to see the historic backwater fishery values of this area maintained. While it is unlikely that the ongoing changes to Lost Island Lake can be halted or reversed, it may be possible to slow the rate of change to maintain backwater fishery habitat values.

6.4.2.9 Environmental Objective #9: Maintain and enhance the diversity and quality of habitat in the lower reaches of Belvidere Slough (RM 740.5 to 744.0).

At its lower end, between Spring Lake and the main channel, Belvidere Slough widens into a broad shallow area with a shifting sand bottom. Within this area are many locations where high ground existed prior to inundation. These areas became island archipelagos after the locks and dams were constructed. Wave action has caused significant erosion of these features.

Measures to protect or create land and/or increase bathymetric diversity would improve habitat quality in this area. Most of the island remnants are adjacent to deeper channels. Reducing the rate of loss of existing islands is important in maintaining the channels and also aquatic vegetation protected by the islands. Recreation of islands would break up wind fetch and help segregate erosion and deposition zones.

6.4.2.10 Environmental Objective #10: Improve habitat diversity in the lower reaches of pool 5 between the lock and dam and river mile 740.5.

In lower pool 5 from Lock and Dam 5 upstream to about river mile 740.5, the river is constrained between the Minnesota mainland and the Lock and Dam 5 dike. This area is devoid of islands and contains some large wing dam fields. The opportunity may exist to improve habitat diversity with wing dam modifications or with the addition of features to promote island formation.

6.4.3 RECREATION

6.4.3.1 Recreation Objective #1: Recognized beach sites within pool 5 should be considered for enhancement as an incidental benefit to this project.

A beach maintenance plan for pool 5 will not be completed for a few years. The LUAP identifies nine areas along the main channel as low density recreation sites, i.e., beaches. Measures to enhance these and other recognized recreational beach sites should be considered in the development of the channel management plan for pool 5.

6.4.3.2 Recreation Objective #2: Adequate water depths (maximum 1.2 meters) should be maintained at river access points to existing public recreational facilities such as parks, boat access facilities, and recognized public recreational beaches.

Maintaining adequate access to public recreational facilities on the river is a significant factor in the ability of the public to use and enjoy these facilities. A water depth of 1.2 meters is considered adequate for the vast majority of recreational craft in use on the river. In many instances, adequate access can be provided with lesser depths. (Private recreational facilities are not included because it is the responsibility of the private sector to maintain access to their facilities. Access to private recreational facilities should not be adversely affected by any proposed actions (see "Planning Constraints"")).

6.4.3.3 Recreation Objective #3: Improve access for small recreational craft into off-channel habitats where such access is consistent with fish and wildlife management objectives.

In a number of locations in pool 5, access for small recreational craft into backwater habitats is hindered by sand shoals across side channel openings. Measures to induce the scouring of

these shoals and to prevent their reformation would allow access into these areas. Improvement of access would need to be consistent with fish and wildlife management objectives for a particular area, e.g., improving access into a waterfowl closed area would be viewed less favorably than a non-closed area.

PLANNING OPPORTUNITIES AND CONSTRAINTS

7.1 PLANNING OPPORTUNITIES

7.1.1 SEDIMENT COMPOSITION AND QUALITY

The sediment found in the main channel of the river in the study area consists of a medium to coarse sand and is relatively free of contaminants. The material is suitable for a number of applications such as fill material and road sanding. Because it is relatively contaminant free, it can be placed in the water for such purposes as island construction. The material is highly suitable for beach nourishment and/or creation.

7.1.2 BED LOAD SEDIMENT TRANSPORT IN LOWER BELVIDERE SLOUGH

A considerable amount of sand appears to be passing through Belvidere Slough. Aerial photographs show shoaling in the lower reaches of the slough where the creation of islands would increase habitat diversity. This situation appears to offer the opportunity to use natural river processes to form islands through the use of experimental seed islands (small obstructions placed in areas of sand transport to stimulate the accretion of material to form islands).

7.2 PLANNING CONSTRAINTS

7.2.1 INSTITUTIONAL

7.2.1.1 Corps of Engineers

Any channel management projects constructed under the authority of the 9-Foot Navigation Channel Project must have as its primary purpose maintenance of the navigation channel. Other purposes may be incorporated into the project to take advantage of planning opportunities or to mitigate adverse project impacts. However, features which have the sole purpose of enhancing non-navigation purposes cannot be constructed using project funds.

7.2.1.2 U.S. Fish and Wildlife Service

Within the study area, much of the area outside the main navigation channel is located within the Upper Mississippi River National Wildlife and Fish Refuge. The evaluation of project alternatives must include consideration of Refuge management goals and objectives.

7.2.1.3 States

Proposed modifications to channel structures and/or other proposed actions are likely to fall, in some manner, under State regulatory purview. State regulatory requirements will need to be considered during the planning and design of any recommended actions.

7.2.2 ENGINEERING

No specific engineering constraints have been identified for this study.

7.2.3 ENVIRONMENTAL

Compliance with all applicable environmental laws and regulations will be required. The following site specific environmental constraints have been identified in pool 5.

Bald eagle nests are located at or near the Finger Lakes, Island 42, and Lost Island Lake. Any measures considered for this area will need to avoid impacting on these nesting sites.

The recommendations of the Weaver Bottoms Task Force for future actions to improve habitat conditions in Weaver Bottoms were considered in the development of a channel management plan for pool 5.

7.2.4 CULTURAL

No specific cultural resource constraints unique to pool 5 were identified. Compliance with all applicable cultural resource laws and regulations will be required.

7.2.5 SOCIOECONOMIC

7.2.5.1 Public Boat Access Points

There are a number of public boat access points in pool 5. Any actions considered for pool 5 should not adversely effect existing boat access to these facilities.

7.2.5.2 Private Recreational Facilities

There are private recreational facilities in pool 5. Any actions considered for pool 5 should not adversely effect existing boat access to these facilities.

ALTERNATIVES

8.1 ALTERNATIVES IDENTIFIED

8.1.1 NO ACTION

Under the no action alternative, no measures would be implemented in the study area under the St. Paul District's channel management program.

8.1.2 ACTION ITEMS

The following action items were identified by the Corps of Engineers and river resource management agencies as areas where specific actions may contribute to meeting the planning goals and objectives. During the feasibility phase of the study, some of these action items may remain as independent alternatives, while other may become combined to form other alternatives. Additionally, these action items will become more defined.

8.1.2.1 Channel Structures

All of the existing channel structures (wing dams, closure structures, bank revetment) in the study reach were reviewed to determine if they were still functional and/or necessary for maintenance of the navigation project. In addition, they were reviewed to determine if notching or other modifications would provide habitat benefits. In areas of identified problems, the need for new structures was also evaluated.

There are approximately 170 channel control structures in pool 5. Appendix B contains a catalog of these structures. They are shown on historic maps (plates 4a through 4d) and current channel control photomaps (plates 5a through 5h). Not all of these sources are in 100 percent agreement concerning the status of these structures. The following is how the discrepancies were rectified for this study.

a. <u>Closing Dam 5</u> - Closing dam 5 is located at the head of Wiggle Waggle Slough. This structure is not shown on plate 5a. However, the channel control photomaps were developed for channel maintenance activities and off-channel structures such as closing dam 5 often are not shown on these photomaps. For purposes of this study, it was assumed that closing dam 5 is present in the location shown on plate 4a, though it may be buried by sand.

b. <u>Wing Dam 26</u> - Wing dam 26 is listed in appendix B as removed. However, it is shown to be still present on plate 5a (RM 752.6 right bank). Portions of a wing dam are known to exist in this area as these remnants were tied into the head of Island 40 in 1989. For purposes of this study it was assumed these remnants represented wing dam 26.

c. Closing Dam 28 - Closing dam 28 is located in the channel behind Lanes Island (plate 4a). This structure is not shown on plate 5a. However, off-channel structures are usually not shown on the channel control photomaps. For purposes of this study, it was assumed that closing dam 28 is present in the location shown on plate 4a.

d. Wing Dam 24 - Wing dam 24 is a small wing dam shown on plate 4a but is not shown on plate 5b. For purposes of this study it was assumed that this wing dam still exists and extends out to the channel marker located at RM 750.5.

e. Wing Dam 16 - Wing dam 16 is shown on plate 4a (RM 750.5 left bank) but does not appear on plate 5b. It is likely that this wing dam crosses the side channel opposite the mouth of the Zumbro River and then is buried under the island, similar to wing dam 18 located just upstream.

f. Wing Dam 14 - Wing dam 14 is shown on plate 4a (RM 750.0 left bank) but does not appear on plate 5b. It is likely that this wing dam crosses the side channel opposite the mouth of the Zumbro River and then is buried under the same island as wing dam 16.

g. Closing Dam 7 - Closing dam 7 was a small closure shown on plate 4a (RM 750.3 right bank). The side channel it closed off no longer appears on plate 5b. For purposes of this study it was assumed that closing dam 7 is part of the old revetment that appears on plate 5b in this location. As such, it was not evaluated as an independent structure.

h. Closing Dam 3 - Closing dam 3 was a very small closure shown on plate 4a (RM 750.3 right bank). For purposes of this study it was assumed that closing dam 3 is part of the old revetment that appears on plate 5b in this location. As such, it was not evaluated as an independent structure.

I. Closing Dam 11 - Closing dam 11 is located at the mouth of an opening into the Mosiman's Slough complex on plate 4a (RM 748.8 left bank). This structure is not shown on plate 5a. However, off-channel structures are usually not shown on the photomaps. State resource agency personnel indicate that this structure is still evident. For purposes of this study, it was assumed that closing dam 11 is present in the location shown on plate 4a.

j. Wing Dam 8 and Closing Dam 13 - These two structures are shown on plate 4b at the head of Belvidere Slough. They do not appear on plate 5c and it may be that they have been covered by sediment and/or accreted islands. Because of their size and location they were considered inconsequential structures even if remnants are present. Thus, for purposes of this study it was assumed they are either gone or covered with sediment.

k. Closing Dams 1 and 2 - These closing dams are shown as constructed across the head of Belvidere Slough (plate 4b). They do not appear on plate 5c because of the map shading, though it is known that these structures or their remnants still exist.

l. Wing Dam 39 - Wing dam 39 is shown on plate 4b (RM 747.8 right bank) and is referenced in appendix B. On plate 5c this wing dam is numbered as 171. Appendix B contains no reference to a wing dam 171. Because of these inconsistencies, this structure was referenced in this study as wing dam 39/171.

m. Wing Dam 105 - Wing dam 105 is shown as a small stub at the end of trailer dam 104 on plate 4b (RM 747.5 right bank). This stub does not show up on plate 5c. This stub, if it still exists, was considered inconsequential, and was not evaluated as an independent structure.

n. Wing Dam 88 - Wing dam 88 is a small wing dam appearing on plate 4b (RM 746.6 left bank) but it does not appear on plate 5d. It was assumed for this study that any remnants of this wing dam are associated with the channel marker located at this location. This wing dam was not evaluated as an independent structure.

o. Closing Dam 59 - Closing dam 59 is located in a small side channel on plate 4b (RM 745.6 right bank). It does not appear on plate 5d due to the photomap shading. For purposes of this study it was assumed that this structure was still present.

p. Wing Dam 101 - Wing dam 101 appears on plate 4b (RM 744.7 left bank) but not on plate 5e. There has been considerable historic dredged material deposition in this location. For purposes of this study it was assumed that this wing dam has been buried by this dredged material and as such was not evaluated as part of this study.

q. Wing Dam 48 - Wing dam 48 appears on plate 4c (RM 742.3 right bank) but not on plate 5f. Based on knowledge of the area it is believed that wing dam 48 no longer exists.

r. Closing Dam 8 - Closing dam 8 appears on plate 4c (RM 741.2 left bank) as a small structure off the base of closing dam 1. This structure does not appear on plate 5f. It is not known if this structure still exists. However, it is so small as to be inconsequential and as such was not evaluated as part of this study.

s. Trailer Dam 3 - Trailer dam 3 is shown on plate 4c (RM 740.4 left bank) as an off channel structure near the L/D 5 dike. It is not shown on plate 5g as it would be in the shaded area. For purposes of this study it was assumed that this structure still exists.

t.. Closing Dams 31 and 32 - These are two small closing dams appearing on plate 4d (RM 739.5 and 739.8 right bank, respectively). They do not appear on plate 5g because they would lie in the shaded area. It is not known if these two structures still exist. They were not evaluated as part of this study because they are small and inconsequential.

u. Closing Dam 40 - Closing dam 40 is shown on plate 4d (RM 739.0 left bank) as an off channel structure near the L/D 5 dike. It is not shown on plate 5h as it would be in the shaded area. For purposes of this study it was assumed that this structure still exists.

8.1.2.2. Zumbro River Floodplain Restoration

A conceptual plan that would restore flow to many of the historic channels of the Zumbro River was discussed during early planning stages. Further development and implementation of the conceptual plan is dependent on participation and support of local citizens; Federal, State, and local governments; as well as private organizations interest and expertise in such projects. The plan would include fee title ownership, easements, or cooperative agreements from willing landowners on approximately 2,000 hectares of Zumbro River floodplain land, much of which is currently in agricultural use. Once the necessary real estate rights were obtained, the Zumbro River would be reconnected to its historic floodplain channels.

8.1.2.3 Seed Islands/Island Construction

There appear to be a number of locations in the lower reaches of pool 5 where it may be possible to stimulate the formation of islands by natural processes through the use of seed islands. Construction of islands is also an option in these areas.

8.2 ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION

8.2.1 ZUMBRO RIVER FLOODPLAIN RESTORATION

The flood control project on the lower Zumbro River is an authorized (1965 Flood Control Act) Federal flood control project completed in cooperation with a non-Federal sponsor (Wabasha County). The project was designed to provide approximately 50-year protection to adjacent agricultural lands. Recent analysis (within the last 5 years) associated with proposed maintenance of the channel by the non-Federal sponsor indicates that despite sedimentation in the channel, the project is still functioning to provide the level of protection for which is was designed. Modification of the flood control project, especially the type of modification envisioned by the conceptual plan is outside the purview and authority of the 9-Foot Navigation Channel Project. Changes of this magnitude would require Congressional action to deauthorize the flood control project.

There are authorities other than the 9-Foot Navigation Channel Project authority that provide for review and modification of existing flood control projects. They are:

a. Section 216 of the River and Harbor and Flood Control Act of 1970 (Public Law 91-611) - Section 216 authorizes studies to review the operation of completed Federal projects and recommend project modifications "when found advisable due to significantly changed physical or economic conditions... and for improving the quality of the environment in the overall public interest." An initial appraisal is conducted using O&M funds to determine whether or not a study is warranted. If it is determined that further study is warranted, these studies are conducted in the two phase study process in the same manner as feasibility studies. Project modifications

resulting from a Section 216 investigation have to be cost shared in the same percentages as specified for the project purposes. The recent Water Resources Development Act of 1996 requires flood control projects to be cost shared on a 65 percent Federal - 35 percent non-Federal basis. Thus, it is expected that a modification of the project under Section 216 authority would have to be cost shared at these percentages.

b. Section 1135 of the Water Resources Development Act of 1986, as amended (Public Law 99-662) - The provisions and requirements of Section 1135 authority were described earlier in section 1.6 of this report. The non-Federal sponsor for the Section 1135 project can be an entity different from the non-Federal sponsor of the project being modified.

It should be noted that while both of these authorities allow for modification of an existing flood control project, the project must still be able to function for its original authorized purpose. Deauthorization of the Zumbro River flood control project for environmental restoration purposes would require the concurrence of the project's non-Federal sponsor and, as noted earlier, Congressional action.

FORMULATION/EVALUATION OF ALTERNATIVES AND PLAN SELECTION

Alternatives were formulated to address the problems, goals, and objectives identified in previous sections of this report. Based on screening processes and discussions with river resource management agencies, plan formulation focused on a number of distinct areas where problems or opportunities were identified. While alternatives were formulated and evaluated for these smaller areas, they were also evaluated for their overall contribution to meeting study area goals and objectives.

To facilitate ease of understanding, the discussion of pool 5 in this section has been divided into three subsections. They are as follows:

Upper Pool 5 - This subsection addresses the upper 1/3 of pool 5 from Lock and Dam 4 (RM 752.7) to just above the head of Belvidere Slough (RM 748.3). Most channel structure modifications and other alternatives evaluated for this reach of the pool were for environmental purposes.

Middle Pool 5 - This subsection addresses the middle 1/3 of pool 5 from just above Belvidere Slough (RM 748.3) to below the outlet of Weaver Bottoms (RM 742.5). Channel structure modifications and other alternatives evaluated for this reach of the pool were almost equally divided between channel maintenance purposes and environmental purposes.

Lower Pool 5 - This subsection addresses the lower 1/3 of pool 5 from below the outlet of Weaver Bottoms (RM 742.5) to Lock and Dam 5. All channel structure modifications evaluated for this reach of the pool were for environmental purposes. This are also includes the lower Belvidere Slough area where study focused on island restoration. There are no channel control structures located in the lower Belvidere Slough area.

9.1 UPPER POOL 5

9.1.1 ISLAND 40 STABILIZATION

Environmental objective #2 is to maintain bald eagle perching habitat below Lock and Dam 4, in particular on Island 40. Bank erosion on Island 40 is resulting in the loss of large trees preferred by bald eagles for perching. Because of the high energy environment immediately below Lock and Dam 4, options available to stabilize this island are limited to rock bank protection. A design was developed to stabilize the eroding shoreline at the head of island 40 using rock bank protection.

The design to stabilize the head of Island 40 would require 10,435 cubic meters of rock and would cost approximately $617,000, as follows.

Mobilization	$ 22,000
Rock	535,000
Plans and Specifications	35,000
Construction Management	25,000
Total	$617,000

9.1.1.1 Evaluation

Aerial photos were used to identify the changes that have occurred at the head of Island 40 during the period 1973 through 1994 (plate 6). Analysis indicates approximately 0.4 hectare has eroded off the head of the island during this period. For lack of any information to the contrary, it was assumed that future erosion of the island would continue at this approximate rate. Thus, stabilization of the head of the island would prevent the lost of about 1.0 hectare of island over the next 50 years.

Assuming the island habitat is of optimum value (1.0 habitat suitability index (HSI)), the average annual habitat gain associated with stabilization of the island would be 1.25 AAHU (this also assumes that the aquatic habitat that would be created by erosion of the island would have zero habitat value). Even with these generous assumptions, the average annual cost per AAHU would be about $36,330. This is 10-15 times the cost/AAHU considered acceptable for habitat restoration efforts conducted under the UMRS-EMP program.

One of the primary concerns with erosion of the head of this island is the loss of large trees used as perching sites by bald eagles feeding in the tailwater area of Lock and Dam 4. Island 40 is vegetated by relatively mature bottomland forest. As the head of the island slowly erodes back, there will always be large trees at the water's edge for perch sites. Thus, whether the head

of the island is stabilized or not, it is unlikely that there would be any appreciable effect on bald eagle use of the island.

Stabilizing the head of the island would provide no measurable benefit to maintenance of the navigation channel because the sediment eroded from the island would be a relatively minute portion of the sediment load being transported by the river.

9.1.1.2 Plan Selection

Island 40 is not owned by the Corps of Engineers. Thus, natural resource management authorities cannot be used to stabilize the head of the island.

As stabilization would not provide any benefits toward maintenance of the navigation channel, there would be no justification for stabilizing the island for that purpose.

It is readily evident the head of Island 40 is being eroded due to the concentration of river flows by Lock and Dam 4. Preventing the loss of an estimated 1 hectare of island habitat over the next 50 years would cost a minimum of $36,330/AAHU gained which is considered an unacceptably high cost for the benefits to be achieved.

In consideration of the above, the selected plan in the **no action** alternative. This does not preclude consideration of stabilizing the head of the island under U.S. Fish and Wildlife Service refuge management authorities, Section 1135 authority, or UMRS-EMP authority. However, it should be noted that Corps of Engineer regulations for implementation of habitat restoration projects under the Section 1135 or UMRS-EMP authorities requires quantification of habitat benefits in project justification. At a minimum estimated cost of $36,330/AAHU gained, it is unlikely that the project could be justified under these authorities.

In 1989, the St. Paul District tied the remnants of wing dam 26 into Island 40 to prevent erosion of the shoreline from bypassing wing dam 26. The District will continue to maintain the connection of wing dam 26 to the island.

9.1.2 WIGGLE WAGGLE SLOUGH OUTLET

Wiggle Waggle Slough flows behind Island 40 and reenters the main channel just above wing dam 30. There has been substantial sand deposition in the lower reaches of Wiggle Waggle Slough and notching of wing dam 30 was identified as a possible measure to offset or reduce the effects sand deposition has on flows through Wiggle Waggle Slough.

9.1.2.1 Evaluation

Wing dam 30 appeared to be the controlling structure for flow passing though Wiggle Waggle Slough. However, a site inspection by Minnesota and Wisconsin DNR fishery biologists indicated that wing dam 76 (RM 752.2RB) extends across what has been the outlet to Wiggle Waggle Slough in recent times. Thus, wing dam 76 is the primary control on this outlet and notching wing dam 30 would likely not provide any appreciable benefits re: increasing flow down this channel. Minnesota and Wisconsin DNR fishery biologists are not in favor of notching wing dam 76 because of the relatively good aquatic habitat that exists above and below this structure.

Wiggle Waggle Slough has formed a secondary outlet upstream of the historic outlet. Only time will tell whether this new outlet will eventually become the primary outlet. Consideration was given to plugging this new outlet to force additional flow down the historic outlet channel. This was not considered desirable by Minnesota and Wisconsin DNR fishery biologists as the new outlet currently provides good fish habitat.

9.1.2.2 Plan Selection

The selected plan is **no action**. Minnesota and Wisconsin DNR fishery biologists will continue to monitor habitat conditions in this area. If changing conditions so warrant, the need for channel structure modifications can be reevaluated.

9.1.3 WING DAM 71 (RM 751.8 RB)

In the area of wing dam 71 the main channel border habitat consists primarily of shallow sand flats. Notching of this wing dam was evaluated as a measure to increase local bathymetric diversity. The design evaluated was a notch to elevation 652, with a 5-meter bottom width. The notch would be located approximately 50 meters from the shoreline (plate 7).

Notching would remove an estimated 190 m3 of rock, willows, and sediment. The excavated material would be used to create a submerged trailing dam downstream of the wing dam along one side of the notch.

The estimated cost of notching wing dam 71 (including a prorated portion of mob/demob costs) is $11,250. The average annual cost (50-year project life) would be about $830.

9.1.3.1 Evaluation

It is difficult to predict how successful wing dam notching will be in enhancing bathymetric diversity by creating deep water, low velocity scour holes downstream of the notch. The smallmouth bass habitat model was used to evaluate changes in habitat values (Appendix G). To provide some comparison to the UMRS-EMP habitat projects, habitat units were calculated based on acres, rather than hectares.

WD 71 is approximately 143 meters long. The main channel border habitat downstream of WD 71, up to the next wing dam (WD 68), covers approximately 3.0 ha. Assuming the development of an approximate 0.5 ha scour hole downstream of wing dam 71 following notching, the average annual habitat benefits gain was estimated to be 0.83 units. The average annual cost per habitat unit was estimated to be $996. This compares favorably to average annual costs per habitat unit considered justified under the UMRS-EMP habitat projects program where costs up to $1,500 per habitat unit are common, and where in some instances, costs up to $3,000 per habitat unit have been considered justified.

9.1.3.2 Plan Selection

The selected plan is to **notch wing dam 71** as described above. The habitat benefits associated with the proposed notching were considered sufficient to justify the costs.

9.1.4 WING DAMS 69, 70, AND 72 (RM 751.1-751.4 RB)

In the area of wing dams 69, 70, and 72 the main channel border habitat consists primarily of shallow sand flats. Notching of these wing dams was evaluated as a measure to increase bathymetric diversity by stimulating the formation of a submerged secondary channel through this wing dam field. The design evaluated involves notching the wing dams to elevation 654. The wing dams would be notched fairly wide (30 meters) to maximize flow and scour throughout this secondary channel (plate 7).

Notching wing dams 69, 70 and 72 would remove an estimated 630 m3 of rock, willows, and sediment. The excavated material would be used to stabilize eroding shoreline along a small island in the area.

The estimated cost of notching wing dams 69, 70, and 72 (including a prorated portion of mob/demob costs) is $18,000. The average annual cost (50-year project life) would be about $1,325.

9.1.4.1 Evaluation

It was estimated that 8.6 ha of secondary channel would be enhanced, with increased bathymetric and current velocity diversity through notching of the three wing dams. Assuming an approximate 0.5 ha scour hole would develop downstream of each of the three wing dams that would be notched as part of this secondary channel enhancement effort, the average annual habitat benefits gain was estimated to be 2.43 units. The average annual cost per habitat unit for notching wing dams 69, 70, and 71 was estimated to be $545.

9.1.4.2 Plan Selection

The selected plan is to **notch wing dams 69, 70, and 72** as described above. The habitat benefits associated with the proposed notching were considered sufficient to justify the costs.

9.1.5 WING DAMS 78 AND 79 (RM 750.7-750.8 RB)

Notching of wing dams 78 and 79 was evaluated as a measure to increase bathymetric diversity. The design evaluated was to notch the wing dams to elevation 652, with a 10-meter bottom width.

9.1.5.1 Evaluation

A site inspection by Minnesota and Wisconsin DNR fishery biologists revealed more habitat diversity than that showed on bathymetry maps. It is not known if this was the result of changes that occurred since the bathymetry data was collected (1995). The view of the fishery biologists is that notching these wing dams would likely not provide any appreciable gain in habitat quality in this area.

9.1.5.2 Plan Selection

Because the site inspection by Minnesota and Wisconsin DNR fishery biologists revealed good bathymetric conditions in the area of wing dams 78 and 79, the selected plan is **no action**.

9.1.6 HEAD OF WEST NEWTON CHUTE (RM 750.0 RB)

West Newton Chute is a major secondary channel with a deteriorated closing dam (#4) at its head. Local citizens have expressed concern with deterioration of this structure and erosion of the head of Island 41. Plate 8 shows changes that occurred between 1964 and 1994. The local citizens are concerned with increased flow down West Newton Chute and shoreline erosion. The District agreed to evaluate restoration of closing dam 4 and other measures, recognizing any modifications would have to be justified by benefits to the 9-Foot Navigation Channel Project.

Modifications to this area were evaluated to (1) prevent an increase in flows down West Newton Chute and (2) reduce flows down West Newton Chute. The design developed for evaluation is shown on plates 9 and 10. Based on current site conditions, it was determined that it would be more cost effective to construct a new closing dam at the location shown rather, than try to restore closing dam 4 and reconnect it to the mainland and Island 42.

The top elevation of the submerged portion of the new closing dam design (elev. 652) roughly approximates the existing controlling elevation of the channel bottom in this area. The width of the submerged portion of the closing dam approximates the width of West Newton Chute as evidenced in aerial photographs from 1964 and 1973. The ends of the closing dam would be emergent, sloping up to grade into the existing banks on either end. Portions of the river bank on both ends of the structure would be riprapped to prevent further erosion in these areas.

A design for stabilizing other points of erosion on Island 41 just downstream of the head of West Newton Chute was also developed. At two of the sites, daymarks that have become detached from the shoreline would be reconnected to the shoreline with rock to provide a hardened point against erosion.

The measures designed for the head of West Newton Chute can be considered in incremental fashion. Stabilizing the head of Island 42 to prevent West Newton Chute from eroding wider would be the first increment. The second increment would be to reconstruct closing dam 4 which would require the addition of rock along the Minnesota shoreline. This would offset some of the changes that have occurred over the past two decades and return flow distributions roughly to as they existed in 1973. The final increment would be additional bank stabilization on Island 42. The cost estimates for the three increments are shown below.

	Feature Cost	Cumulative Cost
Increment 1 (stabilize the head of Island 42)		
Mobilization	$ 22,000	
Rock (1,605 m3)	84,000	
Plans & Specifications	20,000	
Construction Management	12,000	
Subtotal	$138,000	$138,000
Ave. Annual Cost	$ 10,200	$ 10,200
Increment 2 (construct new closing dam)		
Rock for Closing Dam (4,965 m3)	$255,000	
Rock for Bank Protection (295 m3)	19,000	
Plans & Specifications	13,000	
Construction Management	10,000	
Subtotal	$297,000	$435,000
Ave. Annual Cost	$ 21,800	$ 32,000
Increment 3 (additional bank protection)		
Rock (2,015 m3)	$116,000	
Plans & Specifications	7,000	
Construction Management	8,000	
Subtotal	$131,000	$566,000
Ave. Annual Cost	$ 9,700	$ 41,700

9.1.6.1 Evaluation

Increment #1

Stabilizing the head of Island 42 and placing rock along the mainland at the head of West Newton Chute would be considered "preventive maintenance" from a channel maintenance and navigation safety perspective. The head of West Newton Chute has been enlarging over time, allowing additional flow to pass down West Newton Chute, with less flow down the main channel. Less flow down the main channel can lead to increased shoaling and the potential for groundings by commercial barge tows. Analysis of navigation channel conditions within the St. Paul District clearly shows a relationship between "breakout flows" and dredging requirements (plate 11). (Breakout flows are where water leaves the main channel.) These are no data on what the flow split has been historically at West Newton Chute. Under current "normal" summer conditions, about 22 percent of the river's flow passes down West Newton Chute and about 78 percent flows down the main channel. As a matter of perspective, in pool 5, the more serious

dredging problems occur in reaches where the flow split is such that there is less than 60 percent of the flow in the main channel.

It is not possible to predict how the flow split would change if the head of West Newton Chute were to erode wider because flow down the chute is affected by the geometry of the entire chute. It is expected that the amount of flow down West Newton would tend to increase, but by how much cannot be quantified. A reverse analysis can be used to determine if the potential channel maintenance dredging benefits would justify the costs of the bank stabilization. The average annual cost of the bank stabilization would be about $10,200. At a cost of about $3.90/m3 (cost for hydraulic dredging for the Mule Bend and West Newton dredge cuts), this would be the equivalent to about 2,600 m3 of average annual dredging. The combined average annual dredging quantity for the Mule Bend and West Newton dredge cuts is approximately 12,700 m3. Thus, to justify the bank stabilization solely on channel maintenance savings, it would have to be projected that further erosion at the head of West Newton Chute would shift the flow split in a manner that would increase average annual dredging requirements at the Mule Bend and West Newton dredge cuts by about 20 percent. While this could occur, it is not considered likely. (It should be noted that this analysis does not consider the cost of unloading the dredged material from temporary containment sites to permanent sites.)

There are other unquantifiable factors to be considered in the evaluation of this feature. Two of these factors are imminent closures and groundings which can be considered together. Imminent closure conditions generally require immediate action in the form of maintenance dredging. Because of the emergency nature of the situation, imminent closure dredging probably increases overall District dredging costs due to the nature of the situation and the disruption to overall channel maintenance schedules. Aside from the obvious threat to life and property associated with groundings, there also is the potential for environmental effects associated with tows trying to free themselves or the possibility of a cargo spillage. Suffice it to say, there are sufficient reasons to minimize the potential for imminent closure conditions or groundings.

During the period 1990 through 1998, there were 5 reported barge tow groundings between river mile 747.4 and 748.1. This does not include 'bumpings' (tow touches the bottom but is not grounded) which may have gone unreported during this period.

From an environmental perspective, stabilizing the head of Island 42 will prevent the conversion of bottomland forest island habitat to channel habitat. During the period 1964-1994, approximately 1.5 hectares of island eroded away from that portion of Island 42 that would be protected by bank stabilization under Increment 1. Assuming this approximate rate of erosion would continue into the future, stabilizing the head of Island 42 under Increment 1 would prevent the conversion of 2.5 hectares of bottomland forest habitat to aquatic habitat over the next 50 years. This conversion would be considered insignificant from an overall habitat standpoint because of the abundance of bottomland forest in this region of pool 5, and the fact that the material eroding for the bank is not entering and degrading valuable backwater habitat.

Increment #2

Increment #2 depends upon the implementation of Increment #1. For purposes of this evaluation it was assumed that Increment #1 would be implemented.

A restored closing dam at the head of West Newton Chute would reduce typical summer discharges in West Newton Chute by about 5 to 10 percent. Because West Newton Chute carries about 22 percent of the river's discharge, reducing discharges in West Newton Chute by 5 to 10 percent would increase main channel discharges by about 3 percent.

Increasing main channel discharges could provide a minor benefit by potentially reducing current dredging requirements in the Mule Bend and West Newton dredge cuts. The average annual dredging requirements for these two dredge cuts total approximately 12,700 m3. If it is optimistically assumed that reducing main channel discharges by 3 percent would decrease dredging requirements by 3 percent, and that none of this material would need to be dredged elsewhere lower in the pool, the average annual dredging reduction would be about 380 m3 or less than $2,000. The average annual cost of Increment #2 is about $21,800. To provide $21,800 in average annual dredging savings, average annual dredging requirements would need to be reduced by about 45 percent.

There are no other benefits to restoring the closing dam such as environmental benefits. In fact, the Minnesota Department of Natural Resources expressed concern with the amount of shallow-water habitat that would be converted to rock with this feature, along with concerns that reducing flow in West Newton Chute could lead to increased sedimentation in its lower reaches.

Increment #3

Increment #3 can be evaluated as an independent feature as it is not dependent upon the implementation of Increment #1 and/or Increment #2. This increment would involve stabilization of eroding portions of Island 42. Stabilization would prevent eroded sediment from entering the main channel and possibly having to be dredged. However, the increase to the river's bed load would be so incrementally small that stabilization could not be justified by potential channel maintenance savings.

From an environmental perspective, the bank stabilization would prevent the conversion of bottomland forest island habitat to channel habitat. During the period 1964-1994, approximately 1.1 hectares of island eroded from that portion of Island 42 that would be protected by bank stabilization under Increment 3. Assuming this approximate rate of erosion would continue into the future, stabilizing Island 42 under Increment 3 would prevent the conversion of about 1.8 hectares of bottomland forest habitat to aquatic habitat over the next 50 years. As discussed previously for Increment 1, such a conversion would be considered insignificant from an overall habitat perspective.

9.1.6.2 Plan Selection

There is insufficient justification, either from a channel maintenance/navigation safety perspective and/or a habitat perspective to expend an estimated $131,000 to implement Increment #3, hardening two locations on Island 42 to prevent further bank erosion.

There is insufficient justification from a channel maintenance/navigation safety perspective to expend an estimated $297,000 to implement Increment #2, restoration of the closing dam across the head of West Newton Chute.

Increment #1 involves stabilizing the head of Island 42 to prevent the further widening of West Newton Chute and the possible loss of additional flow from the navigation channel, which in turn could increase channel maintenance dredging in this reach and increase the potential for groundings. Implementation of this feature at an estimated cost of $138,000 is considered justified at this time, primarily from the perspective that eventually the head of this island will likely need to be stabilized to prevent further loss of flow from the navigation channel into West Newton Chute. It would be more economical now to stabilize the island and prevent the loss of flow than at a later date attempt to restore the flow distribution back to present conditions. **The selected plan is to stabilize the head of Island 42.**

9.1.7 WING DAM 17 (RM 749.7 LB)

Wing Dam 17 controls flows to some extent behind a small island located at river mile 749.6. Minnesota and Wisconsin DNR fishery biologists believe that notching this wing dam would help maintain the channel behind this island. The design evaluated involves notching the wing dam to elevation 653, with a notch bottom width of 10 meters (plate 12).

Notching would remove an estimated 340 m3 of rock, willows, and sediment. The excavated material would be used to stabilize eroding shoreline on the island.

The estimated cost of notching wing dam 17 (including a prorated portion of mob/demob costs) is $12,600. The average annual cost (50-year project life) would be about $925.

9.1.7.1 Evaluation

It was estimated that 1.3 ha of secondary channel would be enhanced with increased bathymetric and current velocity diversity through notching of the three wing dams. Assuming an approximate 0.5 ha scour hole would develop downstream of the notched wing dam, the average annual habitat benefits gain was estimated to be 0.53 units. The average annual cost per habitat unit for notching wing dam 17 was estimated to be $1,758.

9.1.7.2 Plan Selection

The selected plan is to **notch wing dam 17** as described above. The habitat benefits associated with the proposed notching were considered sufficient to justify the costs.

9.1.8 WING DAMS 46 and 89 (RM 749.3-749.4 LB)

In the area of wing dams 46 and 89 the main channel border habitat consists primarily of shallow sand flats. Notching of these wing dams was evaluated as a measure to increase local bathymetric diversity. The design evaluated was to notch these wing dams to elevation 652, with a 10- and 5-meter bottom width, respectively.

9.1.8.1 Evaluation

Based on habitat conditions observed during an on-site inspection, Minnesota and Wisconsin DNR fishery biologists believe localized bathymetric diversity in the area of these wing dams is acceptable. They recommended that notching of these wing dams not be pursued any further.

9.1.8.2 Plan Selection

Based on the recommendations of the Minnesota and Wisconsin DNR fishery biologists, the selected plan is **no action.**

9.1.9 WILLOWCAT SLOUGH (RM 748.4 RB)

Sedimentation has closed off the head of this slough. There was a significant winterkill, including catfish, throughout the slough in late February of 1998 (Dan Dieterman, Minnesota DNR, personal communication).

No structural solution could be identified that would control the sedimentation problem at the head of Willowcat Slough. Potential restorative measures identified for Willowcat Slough include:

o Cut up and remove portions of trees and/or snags that may be restricting flow through slough.

o Dredge the sand plug from the entrance to the slough. Periodic dredging of the sand plug may be the only solution for keeping the slough open.

o Experiment with gate settings on the Island 42 culvert, including conducting dye studies, to determine the most optimal circulation patterns throughout the Island 42 complex, including Willowcat Slough.

9.1.9.1 Evaluation

One of the difficulties with the Willowcat Slough situation is that no specific habitat objectives exist for this slough, other than the general goal of maintaining Willowcat Slough as a running slough roughly as it has existed in the past few decades. Quantitative objectives, such as how much flow is desirable at various times of the year, have not been developed.

A review of historic aerial photos indicates that Willowcat Slough never was a "natural" slough from the perspective that it was formed by natural river processes. The area now occupied as Willowcat Slough was at one time part of the main channel. Construction of wing dams for early navigation projects and subsequent sand accretion below the wing dams formed a small body of water between the original Island 42 shoreline and the newly accreted sand at the outer edges of the wing dams. This small body of water would eventually become the area now called Willowcat Slough.

When pool 5 was created in the late 1930's, the increased water levels resulted in a direct water connection between the main channel, the area now called Willowcat Slough, and the sloughs and wetlands in the interior of Island 42. The unusual way it was formed probably explains why Willowcat Slough initially flows in an "upstream" direction from the main channel, as compared to most sloughs which flow laterally or in a downstream direction. The accreted sand eventually became vegetated and is now impossible to discern from the original Island 42.

Removing trees and/or snags that may be restricting flow in the downstream portions of the slough would probably not accomplish much because the mouth of the slough is entirely plugged with sand.

Because the head of Willowcat Slough has become completely plugged, experimenting with the gate setting on the Island 42 culvert would likely provide few meaningful results.

Dredging the sand plug from the entrance to the slough would not be a permanent solution, though it could have lasting benefits. The entrance to the slough was dredged in 1982. In 1989 aerial photographs the dredged channel is still well defined. In 1993 aerial photographs the channel is still relatively well defined but a snag is evident at the entrance. It is possible that this snag at the channel entrance is responsible for initiating much of the current sand deposition. The current sand plug at the mouth of the slough is now much more extensive than what existed in the early 1980's.

Dredging in 1982 removed about 3,500 m3 of material, which was sidecast on the channel banks. Because of the more extensive deposition now present, dredging would probably require removal of much more material than in 1982. Because of site constrictions, sidecast disposal is the only feasible option without significantly increasing excavation quantities to allow for side by side barge access. Removal 3,500 m3 with sidecast disposal would cost an estimated $45,000. If quantities were doubled because of the more extensive sedimentation, and if the dredged material had to be removed to an off-site location, the cost of plug removal could quite easily exceed $100,000.

9.1.9.2 Plan Selection

Tree and/or snag removal in the downstream portions of Willowcat Slough or experimenting with different operations at the Island 42 culvert are not meaningful options if the head of Willowcat Slough remains plugged with sand.

Island 42 is owned in fee title by the Corps of Engineers and managed by the U.S. Fish and Wildlife Service under a cooperative agreement. The St. Paul District would have the authority to become involved in removal of the sand plug at the head of Willowcat Slough under Corps natural resource management authorities. Because of natural resource management budget limitations and the fact that dredging the sand plug from the head of Willowcat Slough would only be a temporary solution of unknown duration, the St. Paul District cannot justify this action. Therefore, the selected plan for Willowcat Slough for the St. Paul District is **no action**.

Resource management agencies, most notably the U.S. Fish and Wildlife Service, could pursue removing the sand plug at the head of Wllowcat Slough at their discretion. This problem could be addressed under UMRS-EMP authority if the program is reauthorized. A system-wide habitat needs assessment, scheduled for completion in 2000, may assist in identifying long-term management goals for Willowcat Slough and the Island 42 complex.

9.1.10 SUMMARY FOR UPPER POOL 5

Table 9-1 contains a summary of the selected plans for each of the individual site evaluations for upper pool 5.

Table 9-1
Summary of Selected Plans for Upper Pool 5

Location	Description of Selected Plan
Island 40	No action*
Wiggle Waggle Slough Outlet	No action**
Wing Dam 71	Notch wing dam 71
Wing Dams 69, 70 and 72	Notch wing dams 69, 70, and 72
Wing Dams 78 and 79	No action
Head of West Newton Chute	Stabilize the head of Island 42
Wing Dam 17	Notch wing dam 17
Wing Dams 46 and 89	No action
Willowcat Slough	No action

* the St. Paul District would maintain the wing dam 26 connection to Island 40
** deferred for future consideration if changing conditions so warrant

The following summarizes how the selected actions for upper pool 5 meet or do not meet study goals and objectives.

9.1.10.1 Channel Maintenance/Navigation

The Mule Bend and a portion of the West Newton dredge cut lies within this reach. The only channel maintenance/navigation action selected for this reach is stabilizing the head of Island 42 to prevent an increase in the amount of flow passing down West Newton Chute. This is considered a "preventive maintenance" action, designed to reduce the potential for increased

occurrences of imminent closures and/or groundings in the area of the Mule Bend and West Newton dredge cuts.

9.1.10.2 Environmental

Environmental objective #2 is to maintain bald eagle perching habitat below Lock and Dam 4, particularly on Island 40. Stabilizing the head of Island 40 to protect large perching trees is considered too expensive relative to the estimated habitat benefits. Allowing erosion to continue is not expected to have any appreciable long-term effect on bald eagles as there should always be large trees along the shoreline for use as perching sites. Maintaining the wing dam 26 connection to the head of the island should retard future erosion of the head of this island.

Environmental objective #4 is to prevent the degradation of Mosiman's Slough as a high quality overwintering area for fish. No structural measure was identified that would contribute toward this objective without also entailing a risk of unforseen adverse effects. Habitat quality in Mosiman's Slough is not being threatened to the extent that these risks would be warranted.

Notching 5 wing dams in this reach should provide some localized increases in bathymetric diversity and fish habitat quality, contributing to environmental goal #2 - "restore and enhance habitat quality and diversity within the study area."

No solution to the sedimentation problem at Willowcat Slough is recommended for implementation by the St. Paul District. Dredging or other actions remain an option for implementation by other Federal or State agencies, or under other programs such as the UMRS-EMP.

9.1.10.3 Recreation

Modification of the wing dam and/or closing dam at the entrance to Mosiman's Slough at river mile 748.9 RB was considered to improve small craft access to this area (recreation objective #3). However, no action was pursued because modification of these structures could have the undesirable effect of increasing sediment transport into the Mosiman's Slough area. Small craft access is still possible through the opening at river mile 748.9, especially at higher river stages. In addition, small craft can access the Mosiman's Slough area from downstream.

9.2 MIDDLE POOL 5

9.2.1 HEAD OF BELVIDERE SLOUGH (RM 748.0 LB)

Belvidere Slough is a major secondary channel that carries about 25 percent of the river's discharge. The head of Belvidere Slough is on the outside of a river bend and monitoring of the navigation channel in this area indicates that the channel is shifting toward the head of Belvidere Slough. If left unchecked, this will make this bend increasingly difficult to navigate by commercial barge tows. This problem was identified subsequent to the establishment of specific study objectives. However, this problem would fall under the purview of Channel Maintenance/Navigation study goal #3 - **Reduce or eliminate navigation safety hazards in pool 5** (see page 6-4).

Options identified for this area were (1) no action, (2) remove structures, and (3) modify structures. Option 2 was not considered feasible because removal of structures in this location would only aggravate the shifting of the navigation channel.

The structural modification formulated and evaluated for the head of Belvidere Slough is the fortification of wing dam 9. Bathymetric data indicates the end of wing dam 9 has deteriorated and the wing dam has been breached. Under the design developed, the existing detectable footprint of the wing dam will remain about the same (plate 13). The low points of the wing dam will be built up to within 1.2 meters of the water surface at normal pool (plate 14).

Consideration was given to also stabilizing the head of Belvidere Island to prevent the head of Belvidere Slough from eroding larger. However, an analysis of land/water changes during the period 1974-1992 indicates that the head of Belvidere Island is not appreciably receding (plate 15).

Fortifying wing dam 9 would require 450 m3 of rock and would cost approximately $72,000.

Mobilization	$22,000
Rehab Wing Dam 9	30,000
Plans and Specifications	13,000
Construction Management	7,000
Total	$72,000

9.2.1.1 Evaluation

Fortifying wing dam 9 will prevent the navigation channel from continuing to migrate toward the head of Belvidere Slough. The benefits of this action cannot be quantified. In essence, this action would be considered preventive maintenance. If the channel is allowed to continue to migrate, eventually it would have to be brought back into alignment. Restoring the channel to a previous alignment would cost considerably more than preventing its migration in the first place.

Fortifying wing dam 9 would have negligible environmental effect. Restoring the navigation channel to a previous alignment at a future date if the problem worsens would probably have negative environmental effects.

9.2.1.2 Plan Selection

The primary consideration is that if the navigation channel migration at the head of Belvidere Slough is not curtailed now, it will have to be remedied in the future, probably at a higher cost and likely with some adverse environmental effect. Therefore, the investment of $72,000 at this time to correct the problem is considered justified. Therefore, the selected plan is to **fortify wing dam 9.**

9.2.2 PROBST LAKE

Probst Lake provides valuable overwintering habitat for backwater fish species. Subsequent to the formation of pool 5, a channel has formed connecting Belvidere Slough to Probst Lake. Resource management agencies have expressed concern that this channel has been enlarging and eventually may allow sufficient flow into Probst Lake from Belvidere Slough to degrade the winter habitat quality for fish. Aerial photography indicates that the entrance of this channel increased in width from 35-40 feet in 1973 to 80-90 feet in 1994. Recent surveys indicate the channel entrance is now approximately 100 feet wide. Three options were identified for evaluation, (1) no action, (2) stabilize the channel entrance in its present condition, and (3) reduce the size of the channel entrance. Monitoring of Probst Lake in February 1998 by the Wisconsin DNR indicated good winter habitat conditions and that excessive flow was not entering the lake from Belvidere Slough. Based on this information, it was decided that reducing the size of the channel entrance did not appear necessary. Therefore, a design for this option was not developed.

The design developed for stabilizing the entrance to Probst Lake involves placing a channel liner across the mouth of the channel with some bank protection above and below this structure (plates 13 and 14). This design would require 530 m3 of rock and would cost approximately $76,000.

Mobilization	$22,000
Rock	34,000
Plans and Specifications	13,000
Construction Management	7,000
Total	$76,000

If the project were constructed jointly with the fortification of wing dam 9 (see previous discussion), there would be cost savings from elimination of separate mobilization costs, from the preparation of joint plans and specifications, and from joint construction management. The estimated cost of the Probst Lake channel stabilization with joint construction would be reduced to about $45,000.

9.2.2.1 Evaluation

Stabilizing the head of the channel connecting Belvidere Slough to Probst Lake would prevent this channel from enlarging, resulting in the eventual degradation of Probst Lake as a valuable overwintering area for fish.

An evaluation was conducted to quantify the habitat benefits of stabilizing the Probst Lake channel (table G-10, Appendix G), using the bluegill habitat model. Stabilizing the channel would provide an estimated 5.03 AAHU. With a construction cost of $76,000, the average annual cost per habitat unit would be approximately $1,111/AAHU, a cost considered reasonable for habitat projects constructed under the UMRS-EMP.

9.2.2.2 Plan Selection

The selected plan is to **stabilize the Probst Lake channel** as described above. The habitat benefits associated with the proposed notching were considered sufficient to justify the costs. Because Belvidere Island, including Probst Lake, consists of lands purchased for the 9-Foot Navigation Channel Project, the stabilization of the Probst Lake channel can be accomplished under District natural resource management authorities.

9.2.3 HALF MOON LANDING

Half Moon Landing is a U.S. Fish and Wildlife Service public boat launch facility located on the Minnesota side of the main channel at about river mile 747.5 (plate 16). The boat landing is located off the main channel on Old John's Ditch, a dead end slough that connects with the main channel via Murphy's Cut. In the mid-1980's, flows into Murphy's Cut were reduced as part of the Weaver Bottoms Project by constructing a partial closure structure in Murphy's Cut. In addition, there appears be a natural shift in flow patterns such that additional flow is leaving Murphy's via a slough leading to the upper end of Weaver Bottoms.

Historically, there always has been a sand bar at the head of Murphy's Cut that required caution on the part of recreational boats navigating this area. Now, an additional shoal has formed in Murphy's Cut downstream of the partial closure structure. This shoal formation has likely been caused by the combination of flow reductions from the partial closure structure and the loss of flow to the channel leading to Weaver Bottoms. This shoal is difficult to navigate, especially for recreational boaters who are unfamiliar with the area.

The following were identified as possible solutions to the problem:

o Modify the partial closure structure to allow more flow into Murphy's Cut

o Dredge the shoals

o Stabilize and/or constrict the channel leading to Weaver Bottoms

o Excavate a pilot channel through the downstream shoal

o Channel marking

o Modify Old John's Ditch

9.2.3.1 Evaluation

Modifying the Partial Closure Structure

Modifying the partial closure structure to allow more flow into Murphy's Cut may or may not solve the shoaling problems. It probably would create a larger channel at the head of Murphy's Cut because more water would enter the cut if the constriction at the partial closure structure was eased. Whether the downstream shoal would be reduced is difficult to predict. The additional flow may just result in further enlargement of the channel leading to Weaver Bottoms.

Modifying the partial closure structure is not recommended by the Weaver Bottoms Task Force. The structure is functioning as designed. Allowing more water to enter Weaver Bottoms

via Murphy's cut would detract from its original purpose which was to retard sedimentation in the upper portions of Weaver Bottoms.

Dredging

Dredging the shoal at the head of Murphy's Cut would likely be only a short term solution. It is readily apparent that hydraulic conditions at the head of Murphy's Cut are conducive to the formation of a sand bar in this location. Dredging would not change this.

Dredging of the downstream shoal would also likely be a short term solution. Geomorphology and hydraulic conditions are conducive to having flows follow the channel leading to Weaver Bottoms rather than follow Murphy's Cut to the west to Half Moon Lake. In addition, dredging in this location would be difficult and costly because of access problems and the lack of a disposal site.

Stabilize and/or Constrict the Channel Leading to Weaver Bottoms

Stabilizing this channel to prevent it from enlarging would probably not solve the shoaling problem in that it would maintain the existing flow distributions under which the shoaling problem is occurring. In addition, if flow down Murphy's Cut to the Half Moon Lake area is being impeded by geomorphologic conditions and the channel leading to Weaver Bottoms is stabilized, the water may simply find a new pathway via some other channel leading to Weaver Bottoms.

Constricting the channel leading to Weaver Bottoms to maintain more flow in Murphy's Cut would entail many of the same risks with no guarantee that it would reduce the shoaling in Murphy's cut.

Excavate a Pilot Channel through the Downstream Shoal

There is some flow passing the downstream shoal. Excavating a pilot channel may suffice to concentrate the flow in a channel that is more navigable by recreational craft than the current channel. The longevity of this solution is unknown. There may be sufficient flow to maintain this channel, then again it may fill back in during the next high water event. This solution should be viewed as a relatively inexpensive experiment. If it works, the problem is solved. If it doesn't work, the lost investment would be limited and other more long-term solutions can still be explored.

Marking the Channel

Marking the channel may be an acceptable solution, albeit one requiring periodic maintenance. The channel across the shoals would need to be marked each year following recession of spring high water. The marker buoys would have to be occasionally checked during

the boating season. Marker buoys will not solve the access problem if the downstream shoal become impassable. However, if that situation develops, more long-term solutions can still be pursued.

Modifying Old John's Ditch

At one time, Old John's Ditch was one of the main inlets to the upper Weaver Bottoms area. Construction of the causeway to the West Newton Colony cut off flow to the channel where Half Moon Landing is located. Substantial sedimentation has subsequently occurred in that portion of Old John's Ditch above the causeway. Restoration of flow through Old John's Ditch and the causeway could have an effect on the shoaling problems below the landing and/or provide an alternate route for boats from the landing to the main channel. Restoration of flow would require installing large culverts in the causeway and cleanout of Old John's Ditch. This could a relatively costly restoration effort, depending upon the amount of sediment removal required above the causeway.

9.2.3.2 Plan Selection

The shoaling in Murphy's Cut as it affects access to the Half Moon Landing is primarily a management problem of the U.S. Fish and Wildlife Service. Modification of channel control structures or maintenance practices by the St. Paul District cannot solve the shoaling problem in Murphy's Cut. The St. Paul District will provide **technical assistance** to the U.S. Fish and Wildlife Service if they wish to pursue implementation of any of the measures previously discussed.

9.2.4 ROEBUCK'S RUN (RM746.6 LB)

Roebuck's Run is a secondary channel branching off the left side of the main channel. Concern was expressed by the public after the construction of the Weaver Bottoms Project that flows entering Roebuck's Run were increasing, and that there was additional sediment being transported into Roebucks's Run and subsequently Belvidere Slough, aggravating recreational boat access problems. Ongoing bank erosion is visually evident at the head of Roebuck's Run. Post construction monitoring for the Weaver Bottoms Project indicates that flows in Roebuck's Run have not changed appreciably for low and moderate discharges. However, at high discharges, there has been an increase in flows in Roebuck's Run.

The Below West Newton dredge cut is located immediately below Roebuck's Run. Plate 17 shows the location of past dredging in this area. It is obvious that most dredging has been concentrated in a localized area. A review of dredging records indicates a significant increase in the frequency of dredging in this location.

1975 - 12,400 m3	1993 - 9,400 m3
1983 - 22,600 m3	1994 - 8,400 m3
1986 - 24,200 m3	1995 - 12,100 m3
1988 - 11,500 m3	1996 - 18,100 m3
1990 - 5,500 m3	1997 - 27,900 m3
1991 - 5,900 m3	1998 - 14,000 m3
1992 - 12,800 m3	

Dredging has been required at the Below West Newton dredge cut every year since 1990, and there appears to be a trend toward larger quantities over the last few years. District-wide analysis has shown that many dredging problems are related to loss of flow from the main channel, and pool 5 is no exception (plate 11). It is believed that the increased shoaling that has been observed at the Below West Newton dredge cut is related to the increased loss of flow to Roebuck's Run during high river discharges.

Other concerns associated with Roebuck's Run are:

o If Roebuck's Run continues to enlarge and there is additional loss of flow, the existing outdraft may worsen, creating a navigation safety problem.

o Roebuck's Run feeds directly into Belvidere Slough which is relatively shallow and has sand shoaling that affects recreational boat traffic. Citizens have expressed concern that increased flow and associated sand inputs from Roebuck's Run will only aggravate this problem.

o Evaluation of the Weaver Bottoms Project has led to the determination that more flow should be allowed to enter Weaver Bottoms, and allowing natural enlargement of some the openings into Weaver Bottoms would be the best method for accomplishing this. Most of the

natural enlargement of openings will occur at high river discharges. If a continued increase in the loss of water to Roebuck's Run is allowed, the enlargement of the Weaver Bottom's openings would be retarded due to the lesser hydraulic forces acting on them.

A design was developed to stabilize the head of Roebuck's Run to control further loss of main channel flow. The design involves placing a rock sill in Roebuck's Run connecting the upstream bank with the daymark located at the head of the channel (plate 18). The daymark would be reconnected to the downstream bank of Roebuck's Run by rehabilitating the wing dam that used to connect the daymark to the shoreline.

The rock sill and the daymark tie-in have top widths of 7.6 and 2.4 meters, respectively (plate 19). The rock sill would be 4.3 meters below the surface at normal pool, while the daymark tie-in would be 1.2 meters below the surface. The shoreline tie-ins of these structures would be protected with rock riprap.

The modifications at the head of Roebuck's Run would require 4,300 cubic meters of rock would cost approximately $478,000, as follows.

Mobilization	$ 22,000
Rock sill (3,045 m3)	173,000
Bank protection (4,110 m3)	218,000
Plans and Specifications	40,000
Construction Management	25,000
Total	$478,000

Joint construction of the Roebuck's Run features with rehabilitation of wing dams 84 and 85 (see next subsection) would reduce the cost of these features to about $440,000 due to shared mobilization, plans and specifications, and construction management costs.

9.2.4.1 Evaluation

Stabilization of the head of Roebuck's Run is not expected to result in any substantial reduction in dredging at the Below West Newton dredge cut as the stabilization is primarily designed to prevent conditions from getting worse. It would be very difficult, if not impossible, to predict how dredging requirements at the Below West Newton dredge cut may increase with an increased loss of main channel flow to Roebuck's Run. However, it is possible to evaluate if stabilization is a reasonable investment.

The average annual cost of stabilizing Roebuck's Run at a cost of $478,000 for a 50-year project life would be about $35,200. (The average annual cost would be about $32,400 if constructed jointly with a project to rehabilitate wing dams 84 and 85). The Below West Newton dredge cut is dredged hydraulically with the material normally placed in the Above Fisher Island

containment site. At a cost of $3.90/m3, a reduction in average annual dredging quantities of about 9,025 m3 would be required to consider the project cost effective based solely on dredging requirements. The question then becomes, "if Roebuck's Run is not stabilized, would average annual dredging requirements at the Below West Newton dredge cut increase by 9,025 m3 over the project life?".

A review of dredging records shows that during the period 1975-1988, the average annual dredging requirements at this dredge cut were 5,000 m3. During the period 1989-1998, average annual dredging quantities increased to 11,400 m3. While it cannot be predicted with certainty that average annual dredging quantities will increase by 9,025 m3 in the future, the recent dredging history indicates such an increase may occur if no measures are taken to prevent the loss of additional main channel flow to Roebuck's Run.

No appreciable adverse environmental impacts would be associated with this feature. The conversion of island habitat to flowing channel habitat at the head of Roebuck's Run would be curtailed, but the actual area involved would be too small to have any measurable ecological effect. The rock substrate provided by the structures would provide for some localized habitat diversity.

The recreational boating benefits of reducing sand inputs to Roebuck's Run and Belvidere Slough from what would occur without stabilization cannot be quantified.

The benefits associated with fostering natural enlargement of openings to Weaver Bottoms cannot be quantified.

The benefits of preventing the development of an outdraft that would affect navigation safety cannot be quantified.

9.2.4.2 Plan Selection

While the cost savings associated with preventing future increases in dredging requirements at the Below West Newton dredge cut cannot be specifically quantified, available information indicates that it would be reasonable to expect dredging cost savings commensurate with the cost of the project.

Stabilizing the head of Roebuck's Run would provide other unquantifiable benefits to Weaver Bottoms, navigation safety, and recreational boating in Belvidere Slough.

Based on the expected costs and benefits of this feature, and the lack of any identified adverse effects, the selected plan is to **stabilize the head of Roebuck's Run using a combination of a rock sill and bank stabilization**.

9.2.5 WING DAMS 83, 84, AND 85 (RM 746.8-747.0)

The navigation channel is relatively wide in this area, with a deep point bar (2-3 meters) extending across much of the channel. This is the principal dredging location for the Below West Newton dredge cut (plate 17). Since 1990, this cut has required dredging every year, with an average annual dredging requirement of 12,900 m3. The characteristics of this site are that it has a lot of marginal channel conditions. On two occasions since 1990, dredging has taken place under imminent closure conditions. This site was evaluated to determine if there were measures that could be implemented to make the channel more reliable, and possibly reduce the need for annual maintenance dredging at this site.

The proposed design solution is to modify wing dams 84 and 85 to concentrate navigation channel flows across a narrower area, in turn scouring a deeper navigation channel. Wing dam 84 extends about 93 meters out from the shoreline. Water depths over the outer 40 meters of the wing dam range from about 2.0 to 2.5 meters. The proposed design is to raise wing dam 84 along its entire length to within 1.2 meters of the surface at normal pool elevation and extend the wing dam about 40 meters (plates 20 and 21),

Wing dam 85 is a relatively short wing dam extending out about 50 meters from the shoreline. The proposed design is to extend this wing dam an additional 8 meters. The top elevation of wing dam 85 would be the same as for wing dam 84.

The main channel border in this area consists primarily of shallow sand flats. Notching of wing dams 83, 84, and 85 was evaluated as a measure to increase bathymetric diversity for fish habitat purposes. The following designs were developed and evaluated for these structures.

a. <u>Wing Dam 83</u> - Excavation of a notch with a 3-meter bottom width to elevation 652. Approximately 200 cubic meters of material would be excavated from this wing dam and placed along eroding shorelines in the area for bank stabilization purposes.

b. <u>Wing Dam 84</u> - Restoration of wing dam 84 to elevation 656 and extension by 40 meters. A notch with a 3-meter bottom width would be left in the wing dam for fish habitat purposes. Approximately 710 cubic meters of rock would be required for this feature.

c. <u>Wing Dam 85</u> - Restoration of wing dam 85 to elevation 656 and extension by 8 meters. A notch with a 3-meter bottom width would be left in the wing dam for fish habitat purposes. Approximately 710 cubic meters of rock would be required for this feature.

The modifications of wing dams 83, 84, and 85 would require about 1,885 cubic meters of rock would cost approximately $167,000 as follows.

Mobilization	$ 22,000
Rock	85,000
Plans and Specifications	35,000
Construction Management	25,000
Total	$167,000

The cost of the modifying of wing dams 84 and 85 and the notching of wing dam 83 could be reduced if the project were constructed in conjunction with the Roebuck's Run feature. This would eliminate the need for dual equipment mobilizations, dual contract plans and specifications, and dual construction management costs. Joint construction with the Roebuck's Run feature would reduce the cost of this feature to approximately $135,000.

9.2.5.1 Evaluation

For purposes of this evaluation, it was assumed that the Roebuck's Run stabilization will take place and that channel conditions and dredging requirements at the Below West Newton would not appreciably worsen beyond present conditions.

Modification of wing dams 84 and 85 would concentrate flows in the navigation channel, scouring a deeper channel and improving navigation channel reliability. The primary result should be a safer navigation channel and a reduction in the occurrence of imminent closure conditions at this location. These benefits cannot be quantified.

Though not a primary purpose of the wing dam modifications, it is expected that over the long term, dredging requirements and dredging frequencies at this particular dredge cut will be reduced. Most of the sediment initially scoured from this location as the channel reconfigured itself would likely have to be dredged at one of the dredge cuts located downstream, probably the Fisher Island or Lower Zumbro dredge cut. Eventually, as the channel restabilizes, it is unlikely that all of the material not dredged at the Below West Newton dredge cut would have to be dredged at a lower dredge cut. Some fraction of this material will remain in the bed load sediment transport system. However, it is impossible to predict what this fraction may be.

Modification of wing dams 84 and 85 would have an average annual cost of $12,300. An average annual dredging reduction of about 3,150 m3 would be required to justify the modifications solely on channel maintenance dredging benefits. This would be about a 24 percent reduction of average annual dredging quantities experienced the past decade. It is reasonable to assume that dredging quantities at the Below West Newton dredge cut could be reduced by that much if the proposed modifications are effective. However, it is unlikely that all of these saving would be realized as some of the material not dredged at the Below West Newton

cut would likely need to be dredged at dredge cuts lower in the pool.

The main channel border habitats downstream of WD 83 cover approximately 2.6 hectares. Assuming the development of a 0.5 ha scour hole downstream of the wing dam, the average annual habitat benefit gain is estimated to be 0.78 units. No specific cost estimate was developed for the notching of wing dam 83 as this work was included in the overall cost estimate for modifying wing dams 83, 84, and 85. Using typical costs estimated for other wing dam notchings in this study, the average annual cost of the wing dam 83 notch would be about $415. The average annual cost per habitat unit for notching wing dam 83 would be about $530.

No cost/benefit evaluation was conducted for the notches in wing dams 84 and 85 as these notches would be incorporated into the design of the modifications and should actually reduce costs by reducing the rock required for the modification of these structures.

9.2.5.2 Plan Selection

The modification of wing dams 84 and 85 cannot be justified solely on potential reductions that may occur in dredging quantities. However, that is not the primary purpose of the modifications. The primary purpose is to make the channel more reliable, reducing marginal channel conditions and dredging frequencies. These benefits cannot be quantified. The notching of the wing dams would provide some localized fish habitat benefits.

Based on a weighing of the potential benefits, estimated costs, and lack of adverse effects, the selected plan is to **modify wing dams 83, 84, and 85.**

9.2.6 CLOSING DAM 59 (RM 745.6 RB)

This closing dam is located behind Island 47. This area connects to the outlet of Krueger Slough. Concern was expressed by Minnesota DNR biologists that this closing dam may be affecting sedimentation in the lower end of Krueger Slough. Notching of closing dam 59 was evaluated.

9.2.6.1 Evaluation

From the bathymetry of this area, it is not easy to discern the location of closing dam 59, indicating it has been substantially covered by sand. The bathymetry shows deeper water along the Minnesota shoreline, indicating either a natural breach in the closing dam or that the closing dam is being bypassed. Because of the dynamics of the area, no modifications to closing dam 59 were identified that could assure improved habitat conditions in lower Krueger Slough.

9.2.6.1 Plan Selection

Because of the uncertainty of what habitat changes would occur with modifying closing dam 59, the selected plan is **no action**. Resource agency biologists will continue to monitor habitat conditions in this area. If changing conditions or the development of specific habitat goals for this area so warrant, the modification of closing dam 59 can be reevaluated at that time.

9.2.7 WING DAMS 56 and 98 (RM 745.3 LB)

The main channel border habitat in the area of wing dams 56 and 98 consists primarily of shallow sand flats. Notching of these wing dams was identified as a measure to increase local bathymetric diversity. The design evaluated was to notch these wing dams to an elevation of 652, with a 3-meter bottom width. The notches in WD 56 and 98 would be located approximately 30 and 40 meters from the shoreline, respectively (plate 22).

Notching would remove an estimated 150 m3 of rock, willows, and sediment. The excavated material would be placed along shoreline areas in the vicinity that are eroding.

9.2.7.1 Evaluation

The estimated cost of notching wing dams 56 and 98 (including a prorated portion of mob/demob costs) is $11,250. The average annual cost (50-year project life) would be about $830.

Wing dams 56 and 98 are approximately 55 and 75 meters long, respectively. The main channel border habitats downstream of WD 56 and 98 cover approximately 1.3 and 1.5 ha, respectively. Assuming the development of an approximate 0.5 ha scour hole downstream of wing dams 56 and 98 following notching, the average annual habitat benefit gain was estimated to be 0.53 and 0.56 units, respectively. The average annual cost per habitat unit for notching wing dams 56 and 98 were estimated to be $782 and $745, respectively.

9.2.7.2 Plan Selection

The selected plan is to **notch wing dams 56 and 98** as described above. The habitat benefits associated with the proposed notching were considered sufficient to justify the costs.

9.2.8 WING DAMS 65 AND 106 (RM 743.3 RB)

The main channel border habitat in the area of wing dams 65 and 106 consists primarily of shallow sand flats. Notching of these wing dams was identified as a measure to increase local bathymetric diversity. The design evaluated was to notch the wing dams to an elevation of 652, with a 3-meter bottom width. The notches in WD 65 and 106 would be located approximately 25 and 40 meters of the shoreline, respectively (plate 23).

Notching would remove an estimated 120 m3 of rock, willows, and sediment. The excavated material would be placed along shoreline areas in the vicinity that are eroding.

9.2.8.1 Evaluation

The estimated cost of notching wing dams 65 and 106 (including a prorated portion of mob/demob costs) is $11,250. The average annual cost (50-year project life) would be about $830.

Wing dams 65 and 106 are approximately 75 and 60 meters long, respectively. The main channel border habitats downstream of WD 65 and 106 cover approximately 1.2 ha each. Assuming the development of an approximate 0.5 ha scour hole downstream of wing dams 65 and 106 following notching, the average annual habitat benefit gain was estimated to be 0.50 units for each wing dam. The average annual cost per habitat unit for notching wing dams 65 and 106 is estimated to be $836 each.

9.2.8.2 Plan Selection

The selected plan is to **notch wing dams 65 and 106** as described above. The habitat benefits associated with the proposed notching were considered sufficient to justify the costs.

9.2.9 MINNEISKA BEND

Minneiska Bend is located at river miles 742-743. This is a difficult bend in the navigation channel. It may be possible to reduce the sharpness of this bend with wing dam modifications.

9.2.9.1 Evaluation

Flow from the Whitewater River and Weaver Bottoms enters the main channel in this area. The outlet to Weaver Bottoms (Minnesota 14 structure) was modified in 1997 to alleviate an outdraft problem at this site. It would be premature to consider wing dam modifications in this area until the effects of the 1997 outlet modification can be assessed.

9.2.9.2 Plan Selection

The selected plan for the Minneiska Bend area at this time is **no action**. The situation in this area will be reevaluated in 2-3 years after the effects of the 1997 outlet modifications have been assessed.

9.2.10 WEAVER BOTTOMS

The final report for the Weaver Bottoms Resource Analysis Program (RAP) was completed in September 1998. The report contains a number of recommendations. The following discusses how the recommendations of the RAP were incorporated into this study and its recommendations.

9.2.10.1 Habitat Enhancement Recommendations

Evaluate drawdown as a habitat management measure

Evaluation and implementation of a pool drawdown is beyond the scope of this study (see section 6.1.1). Further initiatives in this area fall under the purview of the Water Level Management Task Force of the River Resources Forum.

Increase side channel flow to Weaver Bottoms

No action is recommended at this time. The situation at Weaver Bottoms will continue to be monitored to see if existing side channel openings enlarge naturally. If this does not occur, or occurs at too slow a rate, enlarging the side channel openings by mechanical means can be pursued in the future.

Additional habitat islands

The CMMP indicates that an estimated 292,000 cubic yards of sand from the Above Fisher Island and the Lost Island containment areas are to be used to construct islands in Weaver Bottoms. Additional sand is already available at these sites if island construction material requirements are larger.

This study will make no recommendation in this area. Procedures are in place to pursue implementation of island construction in Weaver Bottoms under the District's channel maintenance program.

Conduct backwater dredging

This would be accomplished as part of obtaining topsoil for island construction in Weaver Bottoms. This study will make no recommendation in this area.

9.2.10.2 Channel Maintenance Management Plan Recommendations

Find suitable sites for dredged material

Based on material quantities already placed in the Above Fisher Island and Lost Island containment areas, and projected future dredging quantities, constructing islands in the lower Belvidere Slough area (see later discussions in this report) would have no effect on having sufficient dredged material to construct islands in Weaver Bottoms. Using material to construct islands in the lower Belvidere Slough area would extend the capacity of the Lost Island containment site, which in turn could delay the unloading of this site to construct islands in Weaver Bottoms.

If island construction (using channel maintenance material) in the lower Belvidere Slough area is pursued and proves successful, future managers will have to decide how best to achieve island restoration goals in Weaver Bottoms and the lower Belvidere Slough area.

Optimize main channel hydrodynamics and sediment transport

Action is proposed in the Roebuck's Run area to address a localized problem. It appears that a large scale effort to optimize channel hydrodynamics and sediment transport in pool 5 is not realistic. Making the channel more efficient would only aggravate the growing problem of dredging requirements occurring in lower pool 5 beyond present capability to reach designated placement sites using hydraulic equipment.

Making the channel more inefficient to promote dredging near existing placement sites would require diverting large volumes of water to Weaver Bottoms and/or the Belvidere Slough area, which is not considered biologically desirable or politically feasible. In addition, this could have adverse effects on channel reliability and navigation safety. Allowing the Weaver Bottoms openings to enlarge may have a minor effect in making the channel more inefficient.

Stabilize Roebuck's Run

This is being recommended by this study (see section 9.2.4).

Stabilize Lost Island shoreline

This will be accomplished as part of site management for the Lost Island containment site.

9.2.10.3 Watershed/Tributary Management Recommendations

Addressing sediment and erosion concerns in the Zumbro River and Whitewater River watersheds is beyond the scope of this study.

9.2.11 SUMMARY FOR MIDDLE POOL 5

Table 9-2 contains a summary of the selected plans for each of the individual site evaluations for middle pool 5.

Table 9-2
Summary of Selected Plans for Middle Pool 5

Location	Description of Selected Plan
Head of Belvidere Slough	Fortify wing dam 9
Probst Lake	Stabilize the Probst Lake entrance channel
Half Moon Landing	Provide technical assistance to USFWS
Head of Roebuck's Run	Install a rock sill; riprap adjacent islands
Wing Dams 83, 84, and 85	Notch wing dams 83 and 84; restore wing dams 84 and 85
Closing Dam 59	No action*
Wing Dams 56 and 98	Notch wing dams 56 and 98
Wing Dams 65 and 106	Notch wing dams 65 and 106
Minneiska Bend	No action*
Weaver Bottoms	Stabilize Roebuck's Run; monitor MN side channel openings*

* deferred for future consideration if changing conditions so warrant

9.2.11.1 Channel Maintenance/Navigation

The middle reach is the location of most of the channel maintenance/navigation problems in pool 5. No measures were identified that would have any appreciable effects on dredging quantities in this reach. Fortifying wing dam 9 at the head of Belvidere Slough is designed to prevent a shift in the navigation channel, thus avoiding a future navigation problem.

Stabilizing the head of Roebuck's Run is also a "preventive maintenance" type action. Preventing an increase in the amount of flow entering Roebuck's Run will prevent an increase in dredging problems at the Below West Newton dredge cut and control an out-draft that is beginning to develop at this location.

Restoring wing dams 84 and 85 is designed to reduce dredging requirements at the Below West Newton dredge cut. A significant reduction in dredging quantities is not expected as some or most of the material not dredged in this location may have to be dredged at the Fisher Island or Lower Zumbro dredge cuts. However, the frequency of dredging in this location should be reduced, in addition to a reduction in the frequency of marginal channel conditions requiring immediate attention.

9.2.11.2 Environmental

Stabilizing the channel leading to Probst Lake from Belvidere Slough would contribute to environmental objective #5. In addition, notching 7 wing dams in this reach should result in localized increases in bathymetric diversity and fish habitat quality, contributing to environmental goal #2.

Stabilizing the head of Roebuck's Run would not contribute to any environmental goal or objective identified for this study. However, it would contribute to meeting the long term goals established for the Weaver Bottoms area by the Weaver Bottoms Task Force. One of those goals is to allow some of the cuts entering Weaver Bottoms to enlarge naturally. Stabilizing the head of Roebuck's Run will prevent a diversion of flow to Roebuck's Run, maintaining the existing hydraulic forces acting to enlarge the cuts into Weaver Bottoms.

No structural measure was identified that would contribute to the objective of maintaining Krueger Slough as a running slough (environmental objective #7), nor reduce the rate of sand sedimentation into Lost Island Lake (environmental objective #8). Measures to control bank erosion right above the entrance of Lost Island Lake at river mile 744.6 RB are being pursued as part of site management at the Lost Island dredged material placement site.

9.2.11.3 Recreation

Measures were identified that may alleviate the sand sedimentation problems in Murphy's Cut leading to the Half Moon boat landing above Weaver Bottoms. The U.S. Fish and Wildlife Service has the lead in addressing this problem.

9.3 LOWER POOL 5

9.3.1 LOWER POOL WING DAM FIELD

Between river miles 738.9 and 740.4 on the right side of the navigation channel is a large wing dam field of 10-12 wing dams. Much of the area inside of the wing dam field is shallow (< 1.7 meters) and there is a relatively good aquatic plant bed in a portion of this area. This area would be a candidate for a long narrow barrier peninsula connected to the Minnesota Shoreline, a situation that existed prior to the creation of pool 5. The construction of a peninsula and the use of seed islands was evaluated.

Generally, this area has decent bathymetric diversity, with a secondary channel connecting to the deep-water area along the Minnesota shoreline. The wing dams generally have 2.2 meters of water over them. To increase bathymetric diversity, 10-meter bottom width notches were evaluated for wing dams 4, 29, 30, and 33 (plate 24). The bottom of the notches would be at elevation 648.

Notching would remove an estimated 1,035 m3 of rock, willows, and sediment. The excavated material would be mounded to an elevation 656 on the structure next to the notch. Another option to increase bathymetric diversity would be to place new rock in selected areas on the structure to bring these areas to elevation 656.

9.3.1.1 Evaluation

The estimated cost of notching wing dams 4, 29, 30, and 33 (including a prorated portion of mob/demob costs) is $24,750. The average annual cost (50-year project life) would be about $1,820.

Wing dams 4, 29, 30, and 33 vary in total length from 219 to 435 meters, with the main channel border habitat downstream of each of the structures covering from 28 to 66 ha. The main channel border habitat in this wing dam field is fairly deep. Therefore, the main habitat objective was to increase shallow water, rock habitat in this area. Placing the material from notches in the existing structures or new rock as mounds on the wing dams will increase bathymetric and current velocity heterogeneity. However, because the size of the mounds will be relatively small in comparison to the large main channel border habitat in this reach, the increase in diversity and habitat benefits were estimated to be very low. The estimated average annual cost per habitat unit gain for these four wing dams ranges from $296 to $471.

9.3.1.2 Plan Selection

The selected plan is to **notch wing dams 4, 29, 30, and 33** as described above. The habitat benefits associated with the proposed notchings are considered sufficient to justify the costs.

9.3.2 LOWER BELVIDERE SLOUGH

The restoration of islands in pool 5 was identified as a measure that would contribute toward Environmental Goal #2 (restore and enhance habitat quality and diversity) and Environmental Objectives #9 and #10. Lower Belvidere Slough and the lower reaches of pool 5 were identified as the portions of pool 5 where this habitat restoration measure is most needed. An infinite number of island restoration plans could be developed. The first step taken was to develop a conceptual island restoration plan. Primary criteria used in development of the conceptual island restoration plan were:

- locate islands where their presence will stimulate formation or maintenance of deeper channel areas

- locate islands in areas of existing shallow water to minimize the amount of material required for construction

- use island configurations similar to those that would form naturally

Plate 25 shows a conceptual island restoration plan developed for the lower Belvidere Slough area and lower pool 5. The plan shows the restoration of approximately 15 islands. Plate 26 shows the conceptual plan overlaid on existing bathymetry.

It was beyond the scope of this study to evaluate whether any of the islands identified in the conceptual plan are justified based on habitat benefits provided. The primary goal of this study was to determine if any of the islands could be constructed using channel maintenance authorities, or by using channel maintenance authorities in combination with other authorities.

9.3.2.1 Other Authorities

A number of other authorities are available to restore islands in pool 5. They are summarized below with notations concerning their applicability.

__Natural Resource Management__

Island restoration in the Lower Belvidere Slough area could be pursued under the St. Paul District's natural resource management authority. Implementation would require pursuit of funding through the operation and maintenance budget process. Given the scope and funding requirements of such a project, it is unlikely that the project would ever receive funding through this process. Another factor working against a proposal ever being funded at 100 percent Federal cost through the operation and maintenance budget is the availability of cost shared programs for construction of habitat restoration projects.

Section 204

Section 204 provides for aquatic habitat restoration in conjunction with Corps dredged material placement activities. This authority could be used for island restoration in pool 5. A non-Federal sponsor would have to fund 25 percent of restoration costs greater than the cost of placing the dredged material at an approved alternate placement site.

Section 1135

Section 1135 could be used for island restoration. A non-Federal sponsor would be required to fund 25 percent of all project costs. Section 1135 would not require the use of channel maintenance sand for island restoration. If channel maintenance sand were used, it would be advantageous for the non-Federal sponsor to participate in the project under Section 204 authority where only a portion of project costs would be subject to cost sharing.

Section 206

Section 206 could be used for island restoration. A non-Federal sponsor would be required to fund 35 percent of all project costs. However, there would be no reason for a non-Federal sponsor to participate in island restoration under Section 206 because of the more favorable non-Federal cost sharing percentage available under Section 1135. As noted above, if channel maintenance sand were used for island restoration, it would be much more advantageous for a non-Federal sponsor to participate in the project under Section 204 authority.

Section 1103 (UMRS-EMP)

The UMRS-EMP program, if reauthorized, could be used for island restoration. If the program is not reauthorized, there are no remaining unprogrammed funds available for island restoration in pool 5. If the program is reauthorized, island restoration in pool 5 would have to be prioritized within the overall habitat projects program. An obvious advantage of this program to non-Federal interests is that island restoration would be funded at 100 percent Federal cost. A disadvantage is that island restoration in pool 5 may be relegated to a low priority under the UMRS-EMP, and it may be some time before it would be addressed. There would be no such delays if pursued under one of the other authorities requiring cost sharing.

9.3.2.2 Channel Maintenance Authority

Long-term Dredged Material Placement Plan

The approved long-term dredged material placement plan for the lower dredge cuts in pool 5 (Fisher Island, Lower Zumbro, Sommerfield Island) is for the material to be placed in the Above Fisher Island and Lost Island placement sites. When these sites reach capacity, 292,000 cubic yards of material is designated for use in island construction in Weaver Bottoms. Based on

dredging volumes for these dredge cuts and remaining site capacity, it appears these sites have about 17-20 years of channel maintenance material. When the sites require unloading at some time in the future, a reevaluation may be necessary whether to use the material for island construction in Weaver Bottoms, or for other purposes such as island restoration in the lower Belvidere Slough area. It is beyond the scope of this study to address the long-term uses of dredged material placed in these temporary placement sites.

Alternative Placement

The Corps can place dredged material in alternative placement sites to accomplish non-navigation purposes provided the cost of doing so is less than the cost of placing the dredged material in the least cost environmentally acceptable site, in this instance the Lost Island and/or Fisher Island placement sites. (This assumes placing the dredged material in the alternative placement site is acceptable to Federal and State agencies and the public.)

For construction of an island to be more cost effective than barging dredged material to an approved placement site, it would have to be constructed with material dredged hydraulically as part of routine channel maintenance. Constructing an island of mechanically dredged material or mechanically dredged material rehandled hydraulically would not be more cost effective than mechanically dredging and barging the material to the approved placement sites.

9.3.2.3 Island Selection

It was necessary to identify which island from the conceptual plan would be the best candidate for construction using direct placement of channel maintenance material. Most material directly placed to construct islands would be placed using the hydraulic dredge THOMPSON, supplemented with the booster dredge MULLEN. Screening was conducted to identify which islands could be constructed by this method (table 9-3). The practical reach of the THOMPSON and the MULLEN is considered to be about 1,800 m and 1,000 m, respectively. In addition, the MULLEN requires a minimum water depth of about 2 m for access.

The initial screening reduced the number of candidate islands from fifteen to nine. The remaining nine islands were reviewed to determine if there were other reasons why they would not make good candidates for an initial island construction effort using direct placement. Table 9-4 lists those islands screened for reasons other than equipment limitations.

Table 9-3
Island Screening by Equipment Capability

Island	Comment
A	Could not be constructed with direct placement
B	THOMPSON + MULLEN
C	Could not be constructed with direct placement
D	THOMPSON + MULLEN
E	THOMPSON
F	THOMPSON
G	THOMPSON + MULLEN
H	THOMPSON
I	THOMPSON
J	THOMPSON + MULLEN
K	THOMPSON + MULLEN
L	Could not be constructed with direct placement
M	Could not be constructed with direct placement
N	Could not be constructed with direct placement
O	Could not be constructed with direct placement

Table 9-4
Island Screening for Other Reasons

Island	Comment
B	Marginal access for rock placement
D	Poor access for rock placement; at the far end of equipment limitations
F	Marginal access for rock placement; would be difficult to modify design from linear shape
G	Poor access for rock placement
H	Small; would be difficult to modify design from linear shape
I	Located in an area where active shoaling may eventually result in natural island formation
K	Located in deeper water where rock stabilization costs would significantly increase

The secondary screening left islands E and J as the best candidates for construction of an island using direct placement. The layout of island E was modified to a horseshoe or crab-claw shape, similar to island J. Island J is preferred to island E from a habitat perspective because an island constructed at location J would have a larger protected area within the interior of the island. The approximate size of the protected areas would be 11 hectares for island J and 4 hectares for island E. From a cost perspective, island E would be less costly because it would not require the use of the booster dredge MULLEN and the pumping distance for the THOMPSON would be shorter. Both islands were carried through the evaluation process.

9.3.2.4 Small Islands

Most of the islands in the conceptual island plan would require a period of years to construct because there would likely be insufficient quantities of sand available from channel maintenance dredging in any one year to complete an island. Due to concerns with island stabilization and aesthetics during a prolonged construction period, the Wisconsin Department of Natural Resources requested consideration of constructing clusters of small islands with each island constructed with a single channel maintenance dredging event. The Wisconsin DNR suggested placing clusters of small islands in the general locations shown for larger islands B, E, F, and H in the conceptual plan.

9.3.2.5 Island Designs

<u>Large Islands</u>

The initial large island design considered was the most recent being used for islands constructed under the UMRS-EMP habitat projects program (Pool 8 Island Phase II and Polander Lake (pool 5A) projects). This design consists of a sand base constructed to an elevation slightly above project pool elevation. Fine material is used to build up the center of the island to the design elevation. This design maximizes the use of fine materials and minimizes the use of sand, as generally more fishery habitat benefits are obtained from dredging fines from a backwater area than dredging sand from a channel area. Rock stabilization generally consists of groins along the sides, with the island ends hardened with a more traditional riprap design. Vegetative stabilization generally consists of grasses and forbs on the top of the island with willow plantings along the sand berms. Trees may be planted on the islands for habitat purposes.

An initial cost evaluation showed that construction of islands of this design could not be justified under the District's Channel Maintenance Program. The problem with this design lies with the fact that fine materials make up 35 to 45 percent of the island's volume. There is not enough sand material used in island construction to generate sufficient cost savings to compensate for the cost of fine material placement, rock stabilization, and establishment of vegetation. (The cost savings associated with sand placement are due to direct hydraulic placement being less costly than mechanical dredging and barging to a dredged material containment site).

The large island design selected for evaluation was that used for the UMRS-EMP islands constructed in Lake Onalaska (pool 7) and for the Pool 8 Islands Phase I project near Brownsville, Minnesota. With this design, the island cross section consists primarily of sand (plate 27). The fine material portion of the island cross section is limited to a .25-meter layer on top of the island, an amount sufficient for topsoil purposes. The rock stabilization would still consist of groins along the island sides and a more traditional riprap design at the head and on the lower tips of the island.

Because an island constructed using direct placement of channel maintenance material would take a number of years to complete, stabilization of the island in a timely manner is a concern. It would not be cost effective to place fine material on the island with each placement of channel maintenance material. It would be more efficient if all of the fine material could be dredged and placed at one time. To accomplish this, the head of the island was enlarged to provide an area large enough to stockpile sufficient fine material for the entire island. This material could then be placed atop the channel maintenance material as needed.

Estimated material quantities for the large islands are:

	Island J	Island E
sand	120,000 m3	90,000 m3
fines	15,000 m3	12,000 m3
rock	2,500 m3	2,100 m3

Small Island Design

The Wisconsin DNR provided a number of small island designs for consideration. An initial evaluation of those designs indicated that it would be possible to construct small islands in a cost-effective manner. Based on that evaluation, it appeared that for a small island to be cost effective to construct under the District's channel maintenance program, the cost of fine materials and rock protection needed to be kept to 65% or less of the island's cost.

The Wisconsin DNR designs were developed for construction of a single island for waterfowl nesting purposes. These designs did not work well when trying to lay out a cluster of islands over an area with an irregular mixture of water depths suitable and unsuitable for island construction. Therefore, an alternative layout and design were developed for evaluation (plates 28 and 29).

Estimated material quantities for the small islands depicted on plates 28 and 29 are:

	sand	fines	rock
B1	25,000 m3	3,700 m3	650 m3
B2	23,000 m3	3,000 m3	600 m3
E1	36,000 m3	5,600 m3	950 m3
E2	20,000 m3	3,400 m3	900 m3
E3	36,000 m3	5,600 m3	850 m3

9.3.2.6 Evaluation

Island J

The cost evaluation for construction of Island J involves a comparison with the alternative of transporting a similar amount of sand dredged material to the Lost Island containment site. These costs are (rounded to nearest $10,000):

Lost Island Placement		Large Island J Construction	
sand	$940,000	sand	$ 990,000
		fines	300,000
		rock	110,000
total	$940,000	total	$1,400,000

It would be less costly at the present time to place the dredged material from the Minneiska area in the Lost Island containment site than to construct island J However, this does not take into consideration that the material placed in the Lost Island containment site will eventually have to be removed. Based on current capacity and dredging requirements, it is expected that the Lost Island containment site will need to be unloaded in about 18 years. The current plan is that the material from the Lost Island containment site would be used to construct additional islands in the Weaver Bottoms area.

For the present worth analysis, a cost has to be assumed for constructing an island in 2018 with the material from the Lost Island containment site. It should be less costly to construct an island of similar size to island J at one time than in piecemeal fashion over 8 years, though how much less would depend significantly on the location of the island and the design. Therefore, 2018 island construction costs of $800,000, $1,000,000, and $1,200,000 were evaluated. The present worth analysis is shown in table 9-5.

This analysis indicates that it may be less costly to transport the dredged material to the Lost Island containment area and use the material to construct an island approximately 18 years in the

future than to construct an island over the 8-year period of 2001-2008. However, given the level of detail used in the planning and design assumptions and in the cost analyses, a present worth cost difference in the range of $10,000 to $125,000 is considered relatively insignificant. For practical planning purposes, the long term costs of following the dredged material placement plan outlined in the CMMP or constructing island J were considered relatively equal.

From an environmental perspective, there would be minor risks associated with construction of island J to achieve the habitat benefits the island would provide. At various times during construction, portions of the island may be left unprotected without rock protection or topsoil/vegetation for as much as one year. This could lead to erosion of sand material into adjacent habitats. It is not expected that the erosion of material would be significant or that it would result in significant habitat degradation (in fact, depending on depositional patterns, localized habitat diversity could increase); however, it is a concern to the Wisconsin DNR.

Table 9-5
Present Worth Analysis - CMMP Plan vs. Island J Construction

	CMMP Plan		Island J Construction	
Year	Cost	Present Worth	Cost	Present Worth
2001	$ 120,000	$ 110,000	$ 165,000	$ 155,000
2002	120,000	100,000	125,000	110,000
2003	120,000	95,000	375,000	300,000
2004	120,000	90,000	160,000	120,000
2005	120,000	85,000	135,000	95,000
2006	120,000	80,000	135,000	90,000
2007	120,000	75,000	135,000	80,000
2008	120,000	70,000	175,000	100,000
2018*	800,000	220,000		
2018*	1,000,000	280,000		
2018*	1,200,000	335,000		
total	$1,760,000	$ 925,000	$1,405,000	$1,050,000
	1,960,000	985,000		
	2,160,000	1,040,000		

* island construction in Weaver Bottoms

Island E

The cost evaluation for construction of Island E involves a comparison with the alternative of transporting the same amount of dredged material to the Lost Island containment site.

Lost Island Placement		Large Island E Construction	
sand	$710,000	sand	$ 400,000
		fines	250,000
		rock	90,000
total	$710,000	total	$ 740,000

It would cost about the same amount to place the dredged material from the Minneiska area in the Lost Island containment site as to construct island E. This does not take into consideration that the material placed in the Lost Island containment site will eventually have to be removed. For the present worth analysis (table 9-6), it was assumed that constructing an island of a size similar to island E using material from the Lost Island containment site in year 2118 would cost in the range of $600,000 to $700,000. The present worth analyses indicates that it would be more cost effective in the long term to construct island E than to follow the plan outlined in the CMMP.

Table 9-6
Present Worth Analysis - CMMP Plan vs. Island E Construction

	CMMP Plan		Island E Construction	
Year	Cost	Present Worth	Cost	Present Worth
2001	$ 120,000	$ 110,000	$ 105,000	$ 100,000
2002	120,000	100,000	65,000	55,000
2003	120,000	95,000	265,000	215,000
2004	120,000	90,000	105,000	80,000
2005	120,000	85,000	80,000	55,000
2006	120,000	80,000	105,000	70,000
2018*	600,000	165,000		
2018*	700,000	195,000		
total	$1,320,000	$ 725,000	$ 725,000	$ 575,000
	1,420,000	755,000		

* island construction in Weaver Bottoms

Small Island Cluster

The cost evaluation for construction of the small island cluster also involves a comparison with the alternative of transporting a similar amount of sand dredged material to the Lost Island containment site.

Lost Island Placement		Island Cluster Construction	
sand	$1,100,000	sand	$ 550,000
		fines	430,000
		rock	180,000
total	$1,100,000	total	$1,160,000

The direct costs indicate that construction of the small island cluster is comparable to the costs of transporting the dredged material to the Lost Island containment site. Table 9-7 contains a present worth analysis that incorporates the additional cost of unloading the Lost Island containment site is about year 2018. This analysis indicates that it is more cost effective over the long term to construct the small island cluster than to transport the dredged material to the Lost Island containment site where eventually it would have to be unloaded.

Table 9-7
Present Worth Analysis - CMMP Plan vs. Small Island Cluster Plan

	CMMP Plan		Island Cluster Construction	
Year	Cost	Present Worth	Cost	Present Worth
2001	$ 285,000	$ 265,000	$ 295,000	$ 275,000
2003	195,000	160,000	205,000	165,000
2005	180,000	125,000	180,000	125,000
2007	285,000	170,000	290,000	175,000
2009	155,000	80,000	190,000	100,000
2018*	1,000,000	280,000		
total	$2,100,000	$1,080,000	$1,160,000	$ 840,000

* island construction in Weaver Bottoms

9.3.2.6 Plan Selection

From strictly the channel maintenance perspective of using the lowest cost, environmentally acceptable method of dredged material placement, construction of either large island E or the small island cluster would be the preferred alternative. Construction of large island J would be considered essentially a break-even proposition vs. the currently approved plan of using the Lost Island containment site with eventual unloading of that site.

If a single large island were to be constructed, large island J is preferred to large island E in terms of potential habitat benefits. Because of concerns with stabilization of a large island over a period of years, natural resource management agencies prefer the construction of a cluster of small islands that can be individually completed with one dredging event. Also, a cluster of small islands has the potential for providing more diverse habitat than a single large island.

The **small island cluster is the selected plan** as it offers habitat improvement in a cost-effective manner and minimizes the potential adverse effects associated with island construction.

9.3.3 SUMMARY FOR LOWER POOL 5

Table 9-8 contains a summary of the selected plans for each of the individual site evaluations for lower pool 5.

Table 9-8
Summary of Selected Plans for Lower Pool 5

Location	Description of Selected Plan
Wing Dams 4, 29, 30, and 33	Notch wing dams 4, 29, 30, and 33
Island Restoration	Construction of a cluster of 5 small islands

9.3.3.1 Channel Maintenance/Navigation

Construction of the small island cluster will reduce the long term costs of channel maintenance in lower pool 5 by approximately $240,000 in present day dollars.

9.3.3.2 Environmental

Notching wing dams 4, 29, 30, and 33 should result in increases in localized bathymetric diversity and fish habitat quality, contributing toward environmental goal #2.

Construction of the small island cluster will increase habitat diversity in the lower Belvidere Slough area, contributing toward environmental goal #2 and environmental objective #9.

9.3.3.3 Recreation

No recreation access problems were identified for the lower reaches of pool 5, nor were any measures identified for consideration to improve recreational access.

SELECTED PLAN WITH DETAILED DESCRIPTION/DESIGN AND CONSTRUCTION CONSIDERATIONS

This section provides more specific information concerning the selected plan and how it would be implemented. Table 10-1 summarizes the features of the selected plan. The source of funding for all of the recommended features would be the St. Paul District's channel maintenance budget for the Mississippi River Nine-Foot Channel Project, save for the Probst Lake channel stabilization which would be funded by the St. Paul District's natural resource management program for the Nine-Foot Channel Project. The implementation date is based on the estimated availability of funds.

Table 10-1
Summary of Selected Plan

Feature	Cost	Estimated Implementation Date
Notch 13 wing dams	$ 89,000	1999 or 2000
Riprap head of Island 42	$ 138,000	1999 or 2000
Fortify wing dam 9	$ 72,000	1999 or 2000
Probst Lake channel stabilization	$ 45,000	1999 or 2000
Roebuck's Run/WD 83, 84, & 85	$ 575,000	1999 or 2000
Island construction	$1,160,000	Summers of 2000 - 2010

10.1 WING DAM NOTCHING

Because of the minor nature of each of the individual wing dam notchings, detailed construction plans will not be required. Notching of the wing dams will be accomplished by the District hired labor crew as it fits into their schedule. It is expected that this work can all be accomplished by the end of the summer of 2000. Implementation will be coordinated with the On-Site Inspection Team.

Table 10-2 summarizes the design parameters for the wing dams selected for notching. It is recognized that coordination with the On-Site Inspection Team may result in modification of these parameters based on site conditions at the time of construction. Plates 30 and 31 show a typical wing dam notch design.

Bathymetric surveys of the notched wing dams will be conducted 3-5 years post-construction and repeated, if necessary, to assess the success of this technique for creating bathymetric diversity. The District will rely upon evaluation by resource management agencies to determine any biological changes that occur as a result of the notching.

Table 10-2
Wing Dam Notching Design Parameters

Wing Dams	Notch Elevation	Notch Width	Excavation Quantity	Material Use
WD71	198.7	5 m	190 m3	in-water for habitat
WD 69, 70, & 72	199.3	30 m	630 m3	shoreline stabilization
WD 17	199.0	10 m	340 m3	shoreline stabilization
WD 83, 84 & 85*	198.7	3 m	200 m3	shoreline stabilization
WD 56 & 98	198.7	3 m	150 m3	shoreline stabilization
WD 65 & 106	198.7	3 m	120 m3	shoreline stabilization
WD 4, 29, 30, & 33	197.5	10 m	1,035 m3	in-water for habitat

* The data and excavation quantity are for wing dam 83 as notches in wing dams 84 and 85 would be created by leaving a notch when these wing dams are restored and/or extended.

10.2 HEAD OF ISLAND 42

Plate 9 contains plan views of the alternatives evaluated for head of West Newton Chute area. The selected plan is the bank protection shown on the head of Island 42 on the first plan view. A typical cross section is shown in section 1 on plate 10. Construction is currently scheduled for 1999 or 2000, depending upon the availability of funds. Construction will be either by the District hired labor crew or by construction contract, depending upon work load demands at the time. However, given the scope of the project, construction by the District hired labor crew is the more likely scenario.

An estimated 1,605 m3 of rock would be required for this feature which would come from a quarry in the area. If the rock comes from a Minnesota quarry, rock loading would probably occur at the Lock and Dam 5 loading dock. Rock loading for projects in pool 5 where the rock has come from a Wisconsin quarry has, in the recent past, taken place at Fountain City, Wisconsin. The District may investigate development of a loading site along the Lock and Dam 5 dike.

Site preparation for project construction would be minimal. No access dredging will be necessary.

No monitoring of this feature is planned, other than periodic visual inspections to evaluate the structural integrity of rock protection.

10.2 HEAD OF BELVIDERE SLOUGH

The selected plan for the head of Belvidere Slough is the fortification of wing dam #9. Plate 13 contains a plan view of the selected plan, while a typical cross section is shown on plate 14. Construction is currently scheduled for 1999 or 2000, depending upon the availability of funds. Construction will be either by the District hired labor crew or by construction contract, depending upon work load demands at the time. However, given the scope of the project, construction by the District hired labor crew is the more likely scenario.

An estimated 450 m3 of rock would be required for these two features which would come from a quarry in the area. Rock loading would take place at a location dependent upon the location of the quarry (see Island 42 discussion).

Site preparation for project construction would be minimal. No access dredging will be necessary.

Monitoring of this feature will consist of post-construction surveys on a periodic basis to evaluate bathymetric changes in the area.

10.3 PROBST LAKE CHANNEL STABILIZATION

The selected plan is to stabilize the channel leading to Probst Lake with a rock liner. Plate 13 contains a plan view of the selected plan, while a typical cross section is shown on plate 14.

Construction is currently scheduled for 1999 or 2000, depending upon the availability of funds. Because of the close proximity, every effort will be made to construct the project concurrently with the rehabilitation of wing dam 9 (see above discussion).

An estimated 530 m3 of rock would be required for this feature which would come from a quarry in the area. Rock loading would take place at a location dependent upon the location of the quarry (see Island 42 discussion).

Site preparation for project construction would be minimal. No access dredging will be necessary. Placement of the rock would require the removal of any snags or fallen trees in the placement areas. The snags and/or trees would be put on Belvidere Island in areas adjacent to the rock work.

No monitoring of this feature is planned, other than periodic visual inspections to evaluate the structural integrity of rock protection.

10.3 ROEBUCK'S RUN AREA

The selected plan for stabilizing Roebuck's Run consists of placing a rock sill across Roebuck's Run, reconnecting the daymark to the shoreline, and bank protection on either side or Roebuck's Run. Plate 18 is a plan view of the selected plan, while typical cross sections are shown on plate 19.

The selected plan for wing dams 83, 84, and 85 is the rehabilitation of wing dam 84 and the extension of wing dam 85. All three wing dams would be notched for fish habitat improvement purposes. Plate 20 is a plan view of the selected plan, while typical cross sections are shown on plate 21.

Construction is currently scheduled for 1999 or 2000, depending upon the availability of funds. Construction will be either by the District hired labor crew or by construction contract, depending upon work load demands at the time.

An estimated 4,300 m3 of rock would be required for the Roebuck's Run features and 1,885 for wing dams 84 and 85 which would come from a quarry in the area. Rock loading would occur as described earlier for the Island 42 stabilization feature.

Site preparation for project construction would be minimal. No access dredging is expected to be necessary. An estimated 200 cubic meters of material would be removed to notch wing dam 83. This material would be placed along an eroding shoreline in the immediate area.

Monitoring of this feature will consist of post-construction surveys on a periodic basis to evaluate bathymetric changes in the area. Periodic visual inspections of the above water portions of the Roebuck's Run feature will be conducted to evaluate the structural integrity of rock protection.

10.4 ISLAND CONSTRUCTION

The selected plan is to construct 5 small islands in the lower Belvidere Slough area using channel maintenance material for the sand bases of the islands. The island layout is as shown on plate 29. The decision to construct an island will be based on channel maintenance dredging requirements in the Minneiska area. Dredging requirements at the Lower Zumbro dredge cut would also be considered as this material from this dredge cut could be used to complete an island if insufficient material is available in the Minneiska area.

If channel surveys show dredging volumes of the approximate size needed to complete one of the islands, a decision will be made whether or not to proceed with island construction at that time. Factors that would enter into this decision would be equipment availability and the capability and time to place topsoil and add rock stabilization to the island. This decision would

be made through the OSIT process. Based on dredging requirements during the period 1990-98 for the Minneiska area and for the Lower Zumbro dredge cut indicate that sufficient quantities of material to construct an island will be dredged, on average, every other year.

The basic cross section of the islands will be similar to that shown for large island J (plate 27). The dimensions will be flexible to accommodate the volume of dredged material available to construct an island. The bottom width of the island will be allowed to vary between 31 and 43 meters. The berm widths will remain a relative constant 10 meters (interior side) and 13 meters (exterior side). The top width of the islands would vary from 8 to 20 meters.

The berm elevation of the islands would be between elevations 201.6m (661.5 ft.) and 202.1m (663.0 ft.). The top elevation of the islands would be between elevations 202.1m (663.0 ft.) and 202.4m (664.0 ft.).

Rock protection would consist primarily of groins spaced about 60m apart, supplemented by rock bank protection on the exposed ends of the islands and other areas deemed necessary. Because the final configuration/design of the islands will not be known until they are constructed, final decisions concerning rock protection will be made at the time of construction.

The islands will be topsoiled with fine material dredged from the general area of island construction. Resource management agencies will be requested to identify locations for fine material where dredging to obtain this material would provide additional habitat benefits. Other considerations will enter into the selection of fine material borrow sources such as equipment accessibility, distance from the islands, and the presence/absence of mussels or aquatic vegetation.

The topsoiled portions of the islands would be seeded with a grass/forb mixture developed in coordination with the U.S. Fish and Wildlife Service and State resource management agencies. Willow plantings would be placed along the shoreline for stability.

The islands will be monitored to evaluate the effectiveness of erosion control measures, both rock and vegetation. The appropriate corrective action will have to be decided upon if and when problems arise.

ENVIRONMENTAL ASSESSMENT

An environmental analysis has been conducted for the proposed action, and a discussion of the impacts follows. As specified by Section 122 of the 1970 Rivers and Harbors Act, the categories of impacts listed in table 11-1 were reviewed and considered in arriving at the final determinations. In accordance with COE regulations (33 CFR 323.4(a)(2)), a Section 404(b)(1) evaluation has been prepared and is contained in Appendix E. State water quality certifications, as required by Section 401 of the Clean Water Act, have been or will be obtained from Minnesota and Wisconsin.

The Final Environmental Impact Statement for the Channel Maintenance Management Plan (COE, 1997) discussed the programmatic effects of the St. Paul District's channel management program. This channel management study for pool 5 is part of that program.

The environmental assessment discusses the effects of the actions recommended for implementation including:

- Notch 14 wing dams to increase habitat diversity and productivity.
- Restoration of one wing dam (wing dam 9) and bank protection at the mouth of the inlet to Probst Lake to prevent enlargement.
- Stabilization of the head of Island 42 with bank protection to retard the loss of flow to West Newton Chute and further aggravation of shoaling/dredging problems.
- Stabilization of the mouth of Roebuck's run with bank protection and a rock sill to reduce out draft problems and the need for imminent or emergency dredging.
- Restoration/modification of wing dams 84 and 85 to reduce imminent or emergency dredging requirements at the Below West Newton dredge cut.
- Construction of small islands (1 to 5) in lower pool 5 with channel maintenance material to improve habitat diversity.

11.1 RELATIONSHIP TO ENVIRONMENTAL REQUIREMENTS

This assessment was prepared and the proposed work designed to comply with all applicable environmental laws and regulations, including the following: National Environmental Policy Act of 1969; Executive Order 11514, Protection and Enhancement of Environmental Quality (as amended in Executive Order 11991); Executive Order 11593, Protection and Enhancement of the Cultural Environment; Executive Order 11990, Protection of Wetlands; Clean Air Act of 1977; Clean Water Act of 1977; Endangered Species Act of 1973; Fish and Wildlife Coordination Act; National Historic Preservation Act; and 40 CFR 1500-1508, Council on Environmental Quality, Regulations for Implementing Procedural Provisions of the National Environmental Policy Act of 1969.

Table 11-1. Environmental Assessment Matrix for Pool 5 Channel Management Plan
Section 122 of the River and Harbor and Flood Control Act of 1970 (P.L. 91-611)

	MAGNITUDE OF PROBABLE EFFECTS						
	BENEFICIAL			NO	ADVERSE		
PARAMETER	SIGNIFICANT	SUBSTANTIAL	MINOR	EFFECT	MINOR	SUBSTANTIAL	SIGNIFICANT
A. SOCIAL EFFECTS							
1. Noise Levels				X			
2. Aesthetic Values				X			
3. Recreational Opportunities				X			
4. Transportation				X			
5. Public Health and Safety				X			
6. Community Cohesion (Sense of Unity)				X			
7. Community Growth and Development				X			
8. Business and Home Relocations				X			
9. Existing/Potential Land Use				X			
10. Controversy				X			
B. ECONOMIC EFFECTS							
1. Property Values				X			
2. Tax Revenue				X			
3. Public Facilities and Services				X			
4. Regional Growth				X			
5. Employment				X			
6. Business Activity				X			
7. Farmland/Food Supply				X			
8. Commercial Navigation			X				
9. Flooding Effects				X			
10. Energy Needs and Resources				X			
C. NATURAL RESOURCE EFFECTS							
1. Air Quality					X		
2. Terrestrial Habitat			X		X		
3. Wetlands			X				
4. Aquatic Habitat					X		
5. Habitat Diversity and Interspersion			X				
6. Biological Productivity			X				
7. Surface Water Quality			X		X		
8. Water Supply				X			
9. Groundwater				X			
10. Soils				X			
11. Threatened or Endangered Species				X			
D. CULTURAL RESOURCE EFFECTS							
1. Historic Architectural Values				X			
2. Pre-Historic & Historic Archeological Values				X			

11.2 NATURAL RESOURCE EFFECTS

11.2.1 AIR QUALITY

The use of heavy equipment for dredging and rock placement would generate air emissions from the use of petroleum products to run the equipment. Very localized, minor degradation of air quality would occur during the construction phase.

11.2.2 WATER QUALITY

See the Section 404(b)(1) evaluation (appendix E) for a more detailed discussion of the impacts on water resources. The mechanical dredging and rock placement activities associated with the modification, repair, or creation of new channel control structures would resuspend river sediments during the operation. Placement of the clean, coarse rock would not cause any appreciable effects on water quality. The effects on surface water quality of the control structure alterations would be confined to a very localized area around each of the construction sites. Hydraulic placement of channel maintenance material and fine-grained material for topsoil at the island site would cause elevated turbidity from the placement of this material and the disturbance of the fine-grained sediments present at the island site. Elevated turbidity and suspended concentrations and suppressed light penetration would occur in a localized area throughout the construction process. This would cause adverse impacts on filter-feeding benthic organisms and the planktonic community. These communities should recover fairly quickly after the project is complete.

The quality of main channel sediments in lower pool 5 which would be used for island construction is generally good. A borrow site for the fine-grained sediments to be used for topsoil on the proposed island has not been identified as of yet. A borrow site in lower pool 5/Spring Lake area that will provide the required material, while providing environmental enhancement, will be identified later. Past chemical analyses of fine-grained backwater sediments in pool 5, indicate that chlorinated hydrocarbons and heavy metals are found at levels typical of backwater sediments on the Upper Mississippi River below Lake Pepin. Because main channel and backwater sediments in pool 5 are relatively clean, contaminants are not expected to be released at concentrations that alone or in combination with other contaminants would cause toxic effects on aquatic organisms. Bioaccumulation of contaminants in aquatic organisms is not anticipated to be a problem, because of the low levels of chlorinated hydrocarbons and heavy metals in the sediments. Once the borrow site(s) for the topsoil has been identified, sediment samples from the borrow area(s) will be analyzed to confirm that sediment quality is similar to past analyzes and should not present toxicological or bioaccumulation problems.

11.2.3 HABITAT

For most of the proposed wing dam notching sites, the effects on hydrodynamic conditions is anticipated to be very localized. Flow through the wing dams notches would be increased, with a resultant scour hole developing downstream of the notch. The small amount of material that would be eroded would become part of the normal bedload moving through the area. In addition to providing localized habitat diversity, wing dams 69, 70 and 72 are being notched to increase flow and water depths in this secondary channel. The main channel border habitat in this area consists of very shallow sand flats. It is hoped that a deeper, higher flow submerged channel would develop in this area.

Material from the notches would be used to create a rock mound, placed on the existing structure, or used for rock groins to stabilize adjacent eroding shorelines. These activities would have very minimal, localized impacts on hydrodynamic conditions.

The purpose of the projects at the mouths of West Newton Chute, Belvedere Slough, and Roebucks Run are to retard or prevent future enlargement of these side channels. Minor reductions in flows (1%) may occur at Roebuck's Run with the more extensive work being proposed for this site, bank protection and a rock sill. However, the main effect on hydrodynamic conditions of all three of these proposals will be to maintain existing flows and sediment transport in these side channels. The lower end of Belvedere Slough, including Lost Island Lake, would continue to experience similar high sedimentation rates.

The combination of the proposed work at the mouth of Roebucks Run and the restoration and/or modification of wing dams 84 and 85 would increase flow slightly in the main channel and reduce flow in the main channel border where the wing dams are located. To reduce the likelihood of excess filling in the main channel border, notches will be placed in the restored wing dams.

Aquatic habitats along the affected shoreline would be negatively affected during construction of the project. However, the completed project would have minor or negligible long-term impacts, mostly beneficial. Stabilizing the shoreline should improve water quality conditions in the immediate area.

Construction of small islands would change the local hydrodynamic conditions; modifying flow distribution patterns, wind fetch, and wave action. Because of the vast expanse of open water in lower pool 5, the effects would be geographically limited to the localized area of the island and immediately adjacent aquatic area. A "shadow zone" covering from 2 to 5 hectares would be established around the islands, which should encourage the establishment of emergent and submergent aquatic vegetation. The foot-print of the islands varies from 1.2 to 2.1 hectares depending on the island. The anticipated shadow zone and size of the islands are summarized below. The proposed islands would also offer some additional protection from wave action for the existing islands.

Island	Foot-print (hectares)	Shadow Zone (hectares)
E1	2	4.8
E2	1.4	3.9
E3	2.1	
B1	1.4	6.3
B2	1.2	1.8

11.2.4 FISH AND WILDLIFE

Short-term, localized adverse impacts will be associated with the reconstruction. Mechanical dredging and rock placement will cause elevated levels of turbidity in the immediate vicinity. However, the material to be dredged is relatively clean, and mechanical placement should assure that no toxic effects occur. During construction, increases in turbidity and suspended solids would have a localized suppressing effect on phytoplankton productivity. These limited local effects would be minor, however, and plankton populations would recover quickly upon completion of construction activities.

During project construction, bird and mammal species in the project vicinity could be negatively affected by the noise and disturbance of heavy equipment operating in the area. The disturbance would be short-term.

Placement of rock obtained from notching the wing dams in either the downstream scour hole area or on the top of the submerged structure would provide substrate suitable for colonization by aquatic invertebrates and cover for fish species. A small rock mound placed downstream of the breach would provide a potential velocity shelter for fish species. The excavated rock/sand will also be used for bank protection of adjacent eroding shores at some of the wing dam notching sites. Benefits to habitat diversity and interspersion would be realized under all the options being considered for the excavated rock from the wing dam notches. An interagency onsite inspection team will decide the best environmental enhancement option for each of the proposed wing dam notches.

Construction of the 5 islands would bury approximately 8.1 hectares of shallow aquatic habitat and the existing benthic organisms present. However, the habitat created would be more diverse. With increased water clarity and additional shallow areas, aquatic vegetation coverage would also increase.

Fish and benthic species would be adversely affected by the proposed dredging activity of

fine material for topsoil. Benthic organisms, including freshwater mussels, that inhabit bottom substrates in these areas would be removed and destroyed by the dredging activity. However, benthic organisms would rapidly recolonize the newly exposed substrate. Therefore, the project effects on benthic organisms would be short-term and minor. Fish species would probably simply avoid the area during the dredging and construction.

This project would improve the habitat for waterfowl by increasing the amounts of both submerged and emergent aquatic vegetation and its interspersion. In addition, the islands proposed for construction would provide areas protected from wind and waves. Once vegetation is established on the islands they would provide additional waterfowl nesting habitat in the area. Located on islands, these areas would provide nesting areas relatively safe from predation.

In addition to providing spawning areas for fish, the rock riprap used for island protection would provide habitat much more productive for macroinvertebrates that what currently exists. Dredging for top soil would provide increased diversity by providing additional deep water areas. At the potential borrow areas for fines, assuming an existing depth of 1 meter and dredging to a depth of 2 meters, approximately 2.2 hectares of deep water habitat would be created. These deep water holes would beneficial for the fish species present.

Reducing or preventing out draft conditions would improve navigation safety and reduce the potential for barge accidents and spills in this reach. This would reduce the risk of a spill of hazardous material, which could have substantial adverse impacts on fish and wildlife resources in pool 5.

11.2.6 THREATENED AND ENDANGERED SPECIES

A biological assessment for the proposed project features has been completed to determine the potential effects on the following Federally listed species: Higgins' eye pearly mussel (Lampsilis higginsi), peregrine falcon (Falco peregrinus), and bald eagle (Haliaetus leucocephalus).

No peregrine falcon nests have been recorded in the immediate vicinity or sighted during visits to the site. Minor disturbances during project construction should not appreciably affect peregrine use of the area during migrations.

The Higgins' eye pearly mussel has not been recorded in the last 30 years in pool 5 or adjoining pools. Mussels sled surveys were conducted in 1993, 1994, and 1998 at the areas in pool 5 that would be impacted by the proposed actions. Only 10 fairly common species of mussels were found in all of these surveys, with threeridge, threehorn, pigtoe, and pimpleback dominating the mussel assemblage. No Higgins' eye pearly mussel were collected. Based on the survey results, with the absence of Higgins' eye pearly mussel, the low diversity, and the low total mussel numbers collected, it is very unlikely that *L. higginsi* is present at any of the proposed project locations. The proposed project should have no effect on the Higgins' eye pearly mussel or its habitat. Confirmation mussel surveys would be done at the specific island

and fine material borrow sites.

Bald eagles use the general project area for breeding and migration. Several active or recently abandoned nesting sites occur in pool 5 and the upper end of pool 5A. There is also a bald eagle night roosting area located in pool 5. No active bald eagle nests are located immediately adjacent to any of the proposed project sites. With the exception of proposed small islands, all the proposed actions occur adjacent to the main navigation, which is already subject to high level of human activities from recreational and commercial traffic. Construction activities could potentially disrupt short-term use of the general area by bald eagles. Decreasing shoreline erosion at the head of Belvedere Slough and Roebucks Run may protect bald eagle perching sites along these shorelines. There would be no project related impacts to the bald eagle.

The proposed project would have no effects on any Federally listed threatened or endangered species or their critical habitat. The U.S. Fish and Wildlife Service concurs with this determination (Appendix F). Confirmation mussel surveys would be completed at the specific proposed island sites and borrow areas for topsoil material for the islands and coordinated with the USFWS prior to construction, to ensure that there would be no impacts on endangered mussels.

A number of State listed fish and mussel species are listed from the project area. Several Wisconsin and/or Minnesota State listed fish species use main channel border or secondary channel habitats, the primary habitat types that would be impacted by the proposed project features. During construction, the placement of rock, sand, or other construction material would temporarily displace any fish from the project locations. No known important spawning or overwintering habitat for State listed fish species would be adversely impacted by the proposed project features. The proposed rock liners and modifications to existing wing dam structures could improve habitat for State listed fish species by providing areas of reduced flow, increased diversity of substrates and water depths, and additional cover. Mussel surveys completed in 1993, 1994 and 1998 at the proposed project locations yielded only commonly occurring species.

It is the St. Paul District's conclusion that the proposed project features would have no more than minor impacts on State listed threatened and endangered fish and mussel species. Because the project would have limited impacts on other natural resources and no impacts on Federally listed threatened and endangered species, no project related impacts on State-listed wildlife and plant species are anticipated. The Minnesota and Wisconsin Department of Natural Resources will receive a copy of this Environmental Assessment. Comments received pertaining to protection of threatened and endangered species will be addressed.

11.3 CULTURAL RESOURCE EFFECTS

Cultural resources considerations for each of the eleven actions under consideration are summarized in table 11-2. Each action category is discussed in more detail below.

Table 11-2
Summary of Cultural Resource Effects

Action	Sites known in vicinity	Wrecks within 1/4 mile	Wing Dam construction dates	Former land form (1915 navigation map)
Wing dam No. 71; notch	none	None	Built 1908, extended 1910	Off Lanes Island
W D 69, 70, 72; notch		None	Built 1908, extended 1910	-1915- 69 & 70 off Lanes Island; 72 off peninsula of Island 42.
Head of West Newton chute: May stabilize shorelines	WB 51, 52, 58, 59, 60	None	Closing dam 4 (to south) built 1880, raised 1911, rebuilt 1910	Minor secondary channel- now much bigger due to new Zumbro route?
WD 17; notch	none	None	Built 1893, rebuilt 1910	off of Island 41 , a WI bottomland
Belvidere Slough; Fortify WD 9	BF 65	None (three wrecks known for junction of West Newton Chute and the main channel just to the south) WEST Newton chute was logging boom area.	WD 9 built 1891. WD 1 &2 (a little farther up head of Belvidere Slough, built 1880	Major secondary channel
Probst Lake; channel liner with bank protection	BF 65	None		Probst lake apparently formed on what was Belvidere Island; post-LD-lake not shown on 1915 map
WD 83, 84, 85; notch and restore	none	This area is just south of the three wrecks mentioned above (the Captain Kidd 1890, the West Newton 1853, and Wreck 178.	Built 1910	Off Weaver Bottom or (now) Fisher Island
WD 56, 98; notch	none	none	56 built 1908; 98 built 1918	Off head of Somerfield Island
WD 65, 106; notch	none	none	65 built 1907; 106 not shown on 1915 map	Formerly had Somerfield Island to east; off Weaver Bottom to west and north
WD 4, 29, 30, 33; notch	none	none	4 built 1879, repaired 1905; 29 & 30 built 1894, 30 repaired 1899; 33 built 1899	Off small MN bottomland
Island creation		none		Islands A, B, E, F, H, I, K & L on former Somerfield Island; Island C on unnamed island between Somerfield Island and Buffalo City; Islands D, G, and J on bottomlands south of Buffalo City; Islands M, N and O on MN bottomlands just north of Chimney Rock (island O appears to be on made land from wing dams).

11.3.1 West Newton Chute (stabilize shorelines)

No archaeological sites or shipwrecks are known for this immediate area, but there is a concentration of five archaeological sites on the Minnesota shore just to the west of the head of West Newton Chute (21 WB 51, 52, 58, 59, and 60). The stabilization work will have no effect on these sites.

11.3.2 Belvidere Slough (fortify Wing Dam No. 9)

Three shipwrecks are known for this area of the river just at the foot of West Newton Chute. The Belvidere Slough head is upstream of these and any work on bank stabilization will not affect any possible remains of these wrecks. The large mound site (47 BF 65) at Indian Point, just inland of the head of the slough, will not be affected by any work on the bank or wing dam. Wing dam 9 was built in 1891 as part of the 4½-foot channel project. Belvidere Slough was closed off with closing dams 1 and 2, just downstream of wing dam 9, in 1880 in the earliest stages of the 4½-foot channel project.

11.3.3 Probst Lake (channel liner & bank protection)

Probst Lake and channel are evidently post-inundation features of the landscape; the 1915 navigation map shows only Belvidere Island in that location. Shoreline surveys showed no sites in the area, and thus the work will have no effect on any historic properties.

11.3.4 Roebuck's Run (rock liner and bank stabilization)

Roebuck's Run is also a relatively recent (post-inundation) channel; the channel now crosses what was in 1915 the center or "waist" of Belvidere Island. No historic properties will be affected by any channel and bank work.

11.3.5 Lower Pool Island Creation

The locations of the proposed islands are on lands now almost entirely inundated. Before the locks and dams were built the landforms were Somerfield Island, lying between Buffalo City and the Weavers Bottom, and various low-lying islands and bottomlands downstream of Somerfield Island. A survey of the lands remaining above water has revealed no archaeological sites or historic properties. I

11.3.6 Wing dams (9; 71; 69, 70 & 72; 17; 83, 84 & 85; 56 & 98; 65 & 106; 4, 29, 30 & 33)

These wing dams that will be affected by the project plans are historic structures, some of them over a century old. They are associated with significant movements in the history of navigation on the Mississippi River, the 4½- and 6-foot channel projects built by the Corps of

Engineers. The wing dams overall as historic structures have not yet been evaluated for their eligibility for inclusion in the National Register of Historic Places. However the structures have been inundated by the 9-foot channel project, and are not visible. Notching and/or fortifying the wing dams will not affect their interpretive potential.

11.4 SOCIOECONOMIC EFFECTS

11.4.1 NOISE

The use of heavy equipment for dredging and rock placement would generate noise. The effects would be considered minor as there are no sensitive receptors near the project sites. In addition, most construction would take place near the main channel where noise associated with recreational boat traffic and commercial barges is relatively commonplace.

11.4.2 AESTHETICS

Notching or reconstruction of wing dams would occur underwater and would not be visible to the public. Bank stabilization at the inlet channel to Probst Lake and Roebucks Run will convert eroding banks to riprapped banks, which at least until the rock weathers, may elicit a negative response. The construction of one or more islands in lower pool 5 would not affect the viewshed from Buffalo City and would not appreciably affect the landscape.

11.4.3 RECREATIONAL RESOURCES

No recreational beaches would be impacted by the proposed bank stabilization efforts. Water depths equal to or greater than 1.2 meters would be maintained over any modified wing dams or the new sill structure at Roebucks Run to minimize impacts on recreational boaters. The wing dam notching and creation of islands in lower pool 5 are intended to increase habitat diversity, which should have a positive impact on recreational use. Sedimentation would continue to occur at similar rates in Belvedere Slough and continue to pose recreational access problems for Buffalo City residents.

11.4.4 COMMERCIAL NAVIGATION

The proposed actions at the head of Belvedere Slough and Roebucks Run and the reconstruction of wing dams 83 and 84 are intended to reduce or prevent future out draft conditions and reduce the need for imminent or emergency dredging. This would improve commercial navigation safety and reduce the likelihood of spills.

11.4.5 CONTROVERSY

Buffalo City residents have expressed concerns about the continued filling in of the Belvedere Slough area. It is likely that the residents of Buffalo City will support the proposed actions at head of Belvedere Slough and Roebucks Run, but will feel that not enough is being done to correct the sedimentation problem in Belvedere Slough.

Residents along West Newton Chute are concerned about erosion of their shoreline and will feel that not enough is being done to correct their erosion problem.

No controversy has surfaced with the proposal to notch wing dams. These actions are being proposed to improve habitat conditions with no long-term adverse impacts identified.

Controlling outflow from the main channel, with the Roebucks Run and Belvedere Slough stabilization efforts, could be viewed by some as continued or further "canalization" of the river.

Historic dredged material placement practices prior to the mid-1970's resulted in the destruction of habitat due to uncontrolled placement of sand. However, no controversy surfaced with the proposed construction of the islands.

11.5 CUMULATIVE IMPACTS

The cumulative impacts of the Channel Management Program have been discussed in detail in COE, 1997. A multitude of factors will affect the future environment of the Upper Mississippi River, and in this case pool 5 in particular: continued operation and maintenance of the navigation system; hydrologic and hydraulic processes in an altered environment; commercial traffic; public use; point and non-point pollution; commercial and residential development; agricultural practices and watershed management; exotic species; and a host of other factors.

Section 3.0 of this document summarizes the historic changes that have occurred in pool 5 as a result of various Federal activities. Section 4.0 of this document provides an overview of projected future conditions in pool 5 in consideration of other non-project related actions and effects. The cumulative impacts of the proposed pool 5 channel management plan have been discussed in preceding sections of this document and are summarized in table 11-1. Briefly, the proposed pool 5 channel management plan would have both beneficial and adverse impacts on aquatic habitats and beneficial impacts on island habitats. The proposed plan would contribute to the goals identified in Section 6.0 of this document by reducing the cost and adverse environmental effects of channel maintenance dredging in pool 5 and would restore and enhance habitat quality and diversity within the study area. The cumulative impacts of the pool 5 channel management plan on the natural environment would be minor in relation to other non-project related impacts.

COORDINATION, PUBLIC VIEWS, AND COMMENTS

Coordination of the study began with the On-Site Inspection Team for pool 5. A public meeting for the study was held on January 23, 1997, in Buffalo City, Wisconsin. The meeting was attended by 16 private citizens and representatives of interested Federal and State agencies. The primary purpose of the public meeting was to obtain public input concerning environmental and recreational problems and concerns in pool 5.

A draft Problem Appraisal Report for the study was provided to the River Resources Forum (RRF) on February 25, 1997. Following receipt of comments, the Problem Appraisal Report was finalized and provided to the RRF on May 6, 1997.

On July 28, 1997, representatives of the St. Paul District, the U.S. Fish and Wildlife Service and Wisconsin and Minnesota Departments of Natural Resources conducted an on-site inspection of various sites in pool 5 identified by the public and the resource agencies as areas of concern.

On May 12, 1998, representatives of the St. Paul District, the U.S. Fish and Wildlife Service and the Minnesota Department of Natural Resources met with local citizens to discuss their concerns with bank erosion on West Newton Channel and how that may be affected by restoration of closing dam 4 at the head of the channel.

Coordination throughout the study was maintained with the On-Site Inspection Team, focusing on those representatives who were active participants in the study. Active participants included representatives of the U.S. Fish and Wildlife Service, the Wisconsin and Minnesota Departments of Natural Resources, and the Minnesota Pollution Control Agency. Formal coordination meetings were held on the dates shown below. Coordination also took place on a regular basis between meetings through more informal means to facilitate the exchange of information.

June 20, 1996	May 18, 1998
October 8, 1996	September 14, 1998
February 11, 1998	December 15, 1998

The draft Definite Project Report/Environmental Assessment was circulated for public review on April 12, 1999. The document was sent to Congressional interests; Federal, State, and Non-Federal agencies; special interest groups; interested citizens; and others as listed in appendix F. Comment letters received and responses (if necessary) are also included in appendix F.

SUMMARY

The purpose of this study was to undertake a holistic evaluation of channel management in pool 5. By necessity, problems, opportunities, and potential solutions had to be evaluated on a localized or site specific basis, within the context of their overall effect within pool 5. A number of specific actions are recommended for implementation (table 10-1, page 10-1).

Four specific actions are recommended to make the navigation channel more reliable, either by reducing existing shoaling problems, or preventing problems from occurring in the future. These actions include stabilizing the head of Island 42, fortification of wing dam #9 at the head of Belvidere Slough, stabilizing Roebuck's Run with a rock sill and bank protection, and modifying of wing dams #84 and #85 near Roebuck's Run.

Construction of a complex of 5 small islands using dredged material is recommended for the lower Belvidere Slough area. Construction of these islands will provide fish and wildlife habitat benefits by increasing habitat diversity in an area where there has been a loss of islands due to erosion. Construction of these islands will also provide a more economical method of dredged material placement for the St. District channel maintenance program, as compared to the currently approved placement plan for lower pool 5.

Fish habitat benefits will be achieved through the notching of wing dams. The notches are designed to promote the formation of scour holes and channels to improve bathymetric diversity in relatively monotypic main channel border areas.

The entrance channel to Probst Lake will be stabilized to prevent its enlargement and to preserve the high quality winter fish habitat in Probst Lake. This feature will be funded by the St. Paul District's natural resource management program.

The above recommended features are not solutions to all of the channel maintenance, environmental, and recreational problems and concerns identified in pool 5. In some instances, cost-effective solutions could not be found. In others, evaluation indicated that a wait-and-see approach was better, especially in areas where conditions are changing due to natural river dynamics. Finally, in some instances, it was identified that solutions lie beyond the purview of the St. Paul District channel maintenance and natural resource management authorities, and other Federal and State agencies will need to take the lead in implementation.

Environmental and Economic Analysis Branch
Planning, Programs and Project Management Division

FINDING OF NO SIGNIFICANT IMPACT

In accordance with the National Environmental Policy Act of 1969, the St. Paul District, Corps of Engineers, has assessed the environmental impacts of the following project.

POOL 5 CHANNEL MANAGEMENT PLAN (CMP)
POOL 5, UPPER MISSISSIPPI RIVER
BUFFALO COUNTY, WISCONSIN, AND WINONA COUNTY, MINNESOTA

The primary purposes of this project are to reduce or control dredging requirements, improve navigation safety, reduce adverse environmental effects of existing channel control structures, and restore natural river processes and functions as much as possible. The following actions are recommended: notching of 14 wing dams to increase habitat diversity and productivity; stabilizing the head of Island 42 with bank protection to retard the loss of flow to West Newton Chute and further aggravation of shoaling/dredging problems; restoring wing dam 9 and stabilizing the mouth of the inlet to Probst Lake to prevent enlargement; stabilizing the mouth of Roebuck's Run with bank protection and a rock liner to reduce outdraft problems; restoring wing dams 84 and 85 to reduce imminent or emergency dredging requirements at the Below West Newton dredge cut; and constructing small islands in lower pool 5 with channel maintenance material to improve habitat diversity.

The proposed actions should have long-term positive impacts on economics and commercial navigation and be environmentally neutral or beneficial. However, short-term, localized, minor adverse environmental impacts would be associated with the construction of the project features. The proposed project will not affect any archeological sites. The St. Paul District, however, has determined that the channel constriction works (wing dams, closing dams and shore protection) associated with the 4.5- and 6-foot channel projects are eligible for the National Register of Historic Places. We are waiting for concurrence from the Minnesota and Wisconsin State Historic Preservation Offices (SHPOs). If the SHPOs concur that the channel constriction works are eligible, then the District will work with the SHPOs to avoid, minimize and/or mitigate any adverse effects that might

occur as a result of wing dam notching, stabilization or restoration. Given the large number of channel constriction works (over 1,000 wing dams above La Crosse, Wisconsin), modifying a few of the wing dams will not constitute a significant effect on the resource overall. Most of the individual wing dams will suffer only minor adverse effects or will be benefited by stabilization and restoration.

This finding of no significant impact is based on the fact that no significant environmental impacts were identified as resulting from the proposed actions. The environmental review indicates that the proposed actions do not constitute a major Federal action significantly affecting the quality of the human environment. Therefore, an environmental impact statement will not be prepared.

26 July 99
Date

Kenneth S. Kasprisin
Colonel, Corps of Engineers
District Engineer

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PLATES

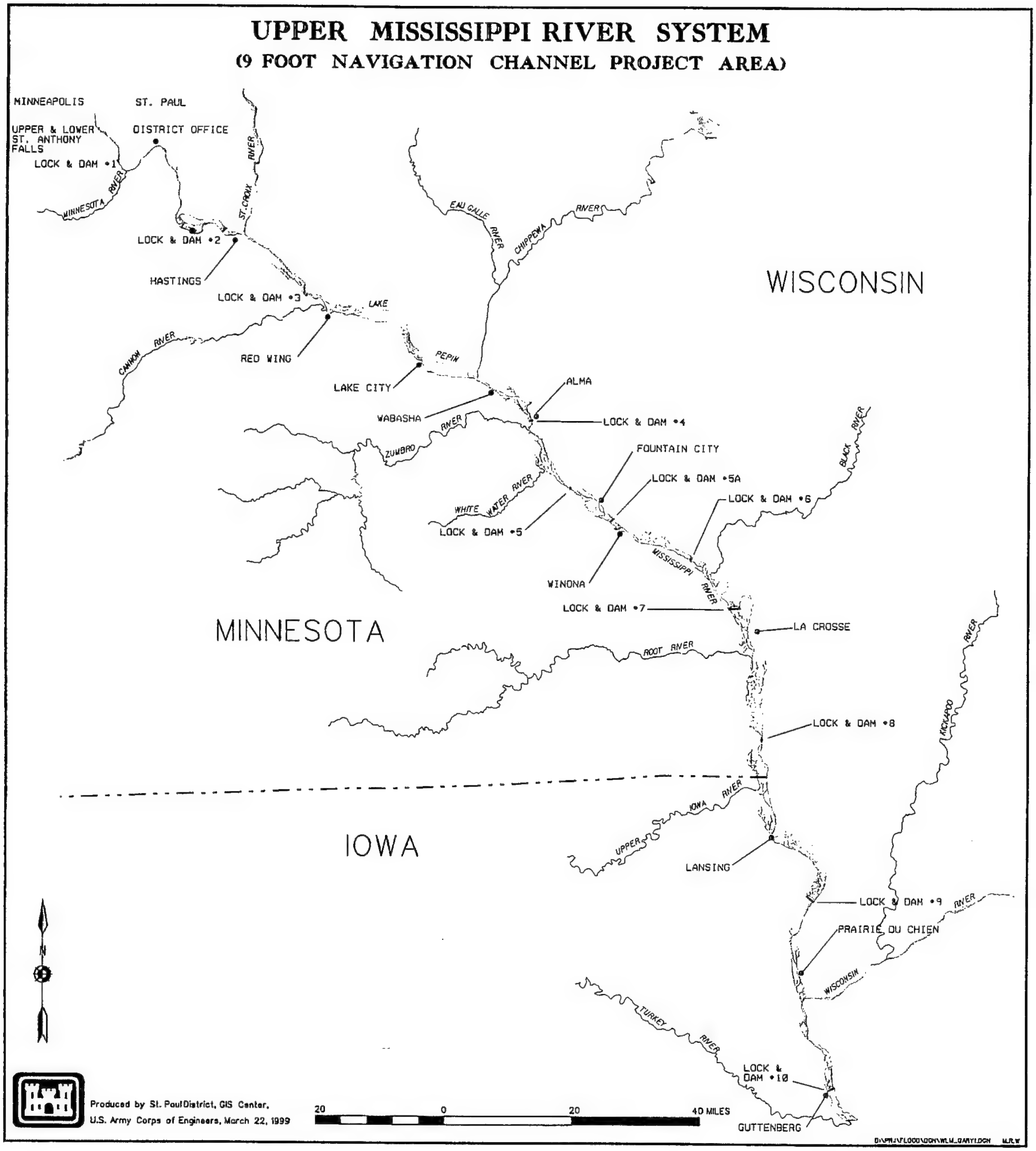


Plate 1. General Location Map

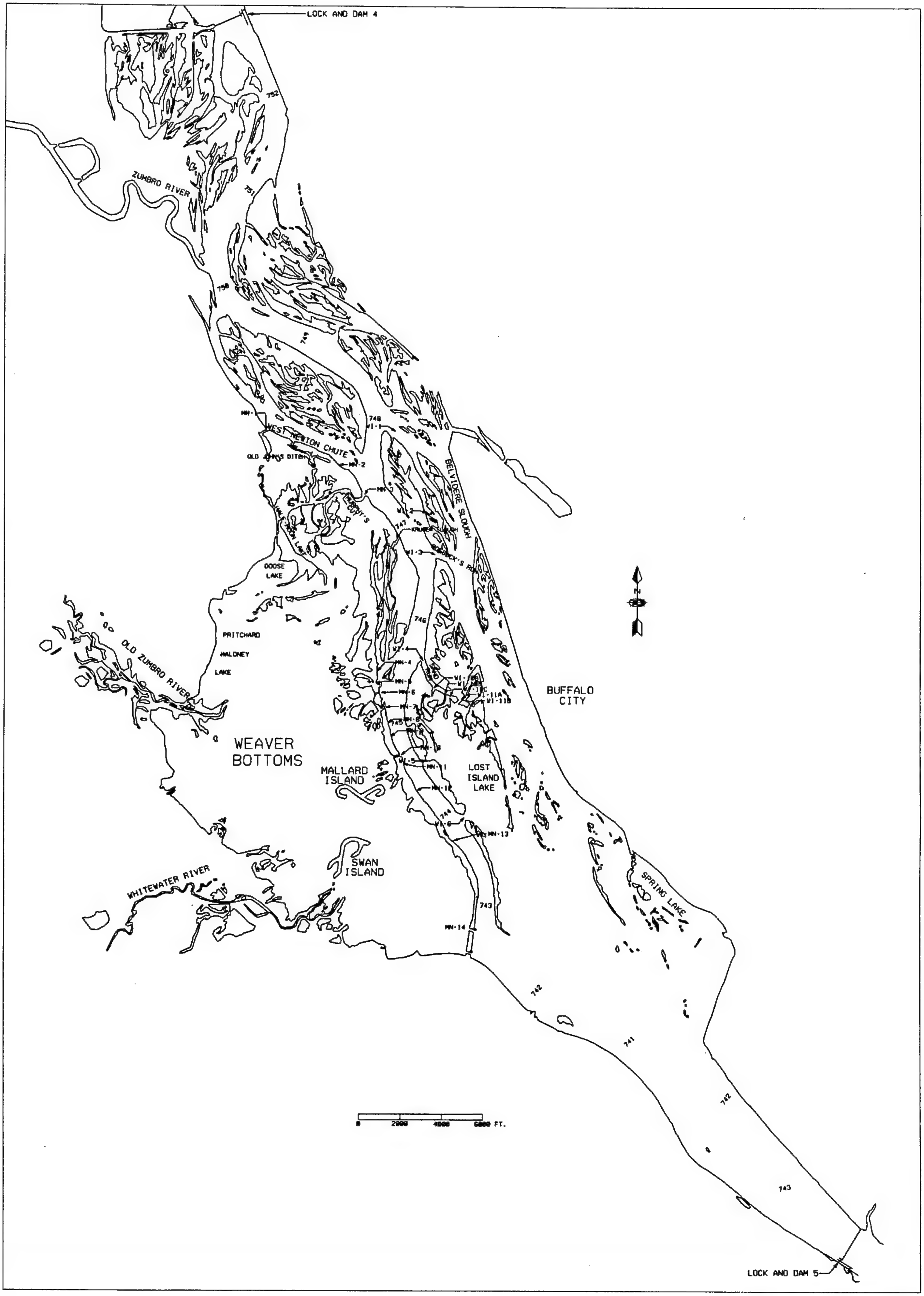
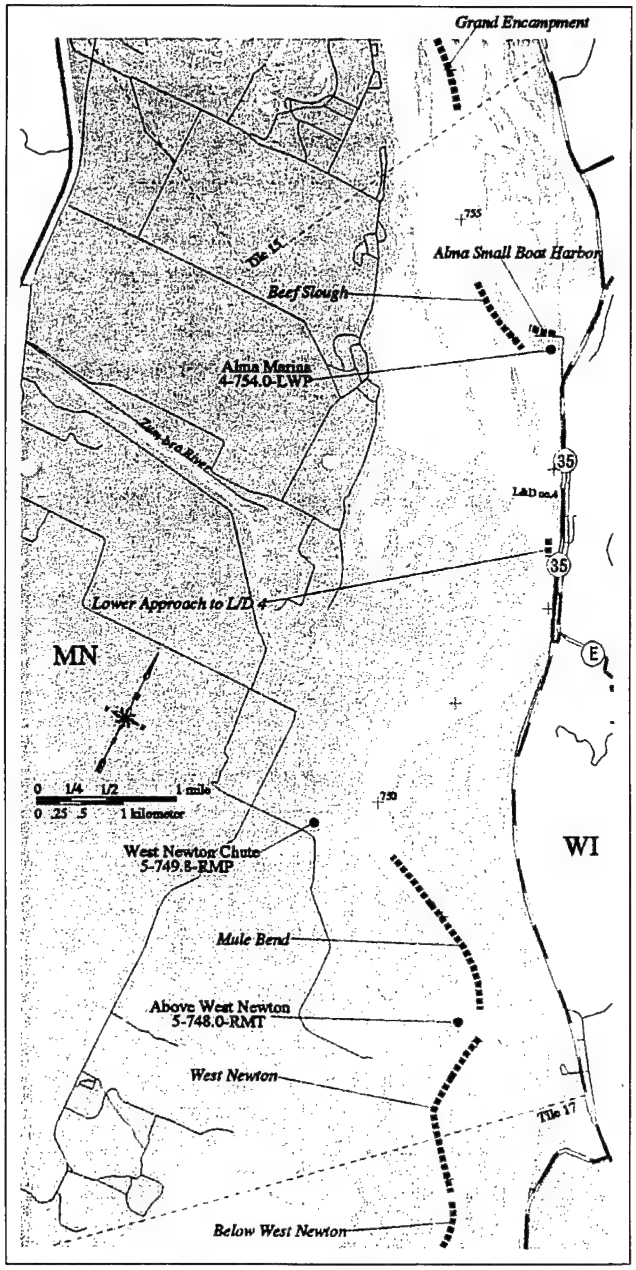
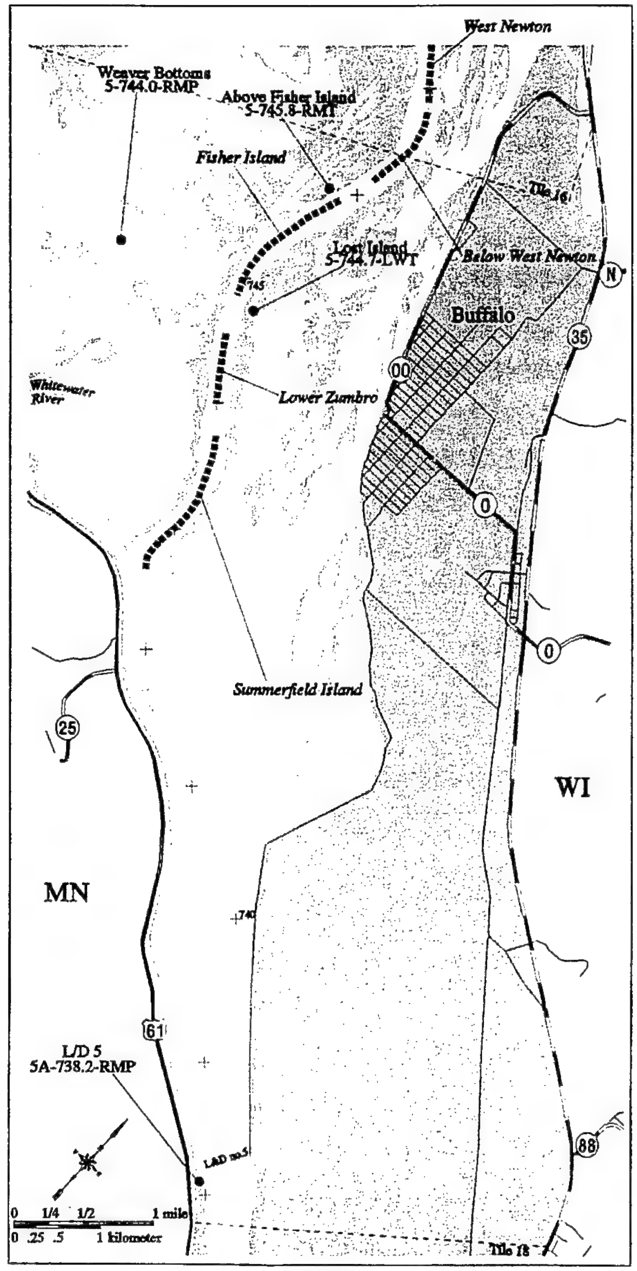


Plate 2. Pool 5 Map

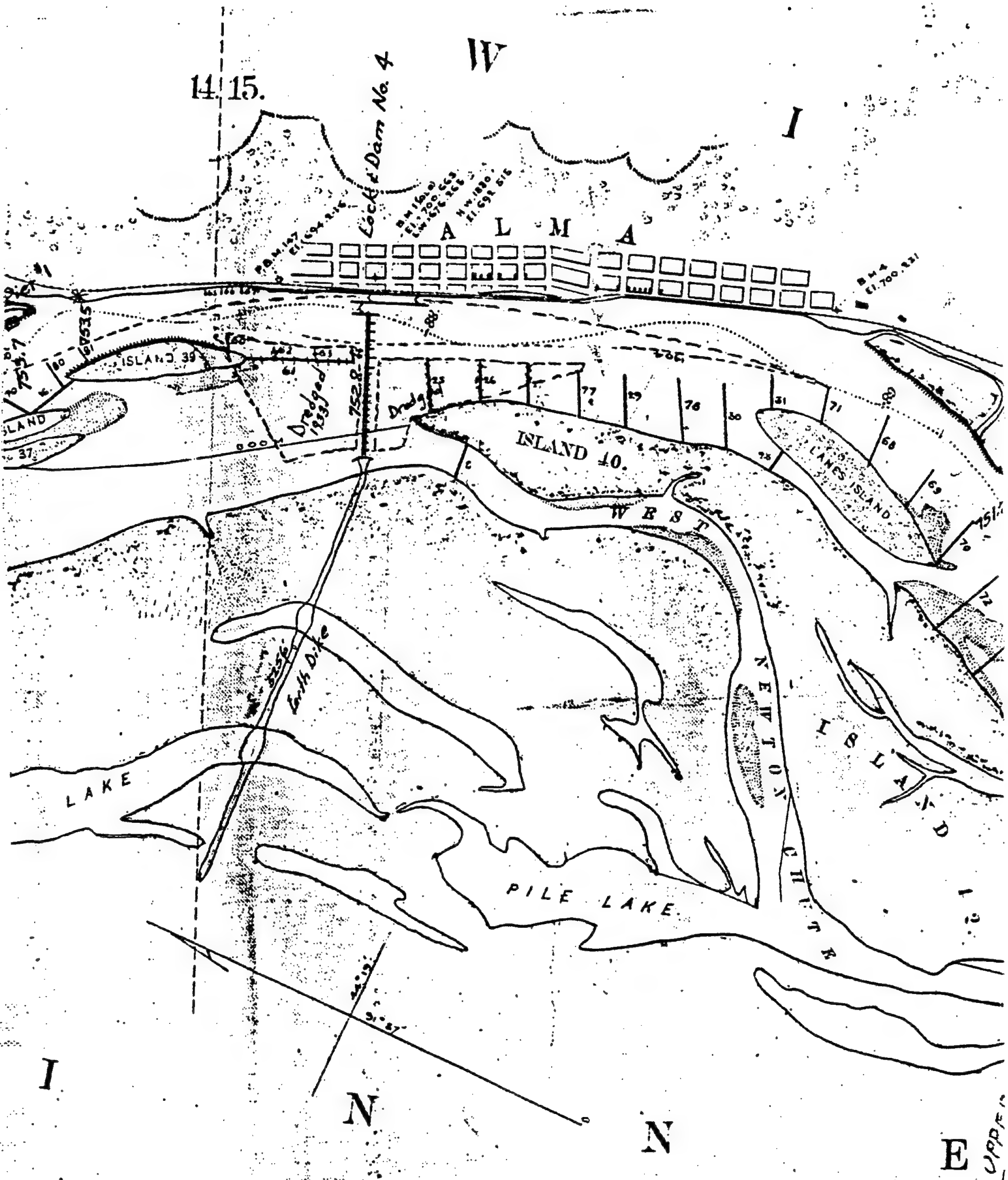


Tile 16

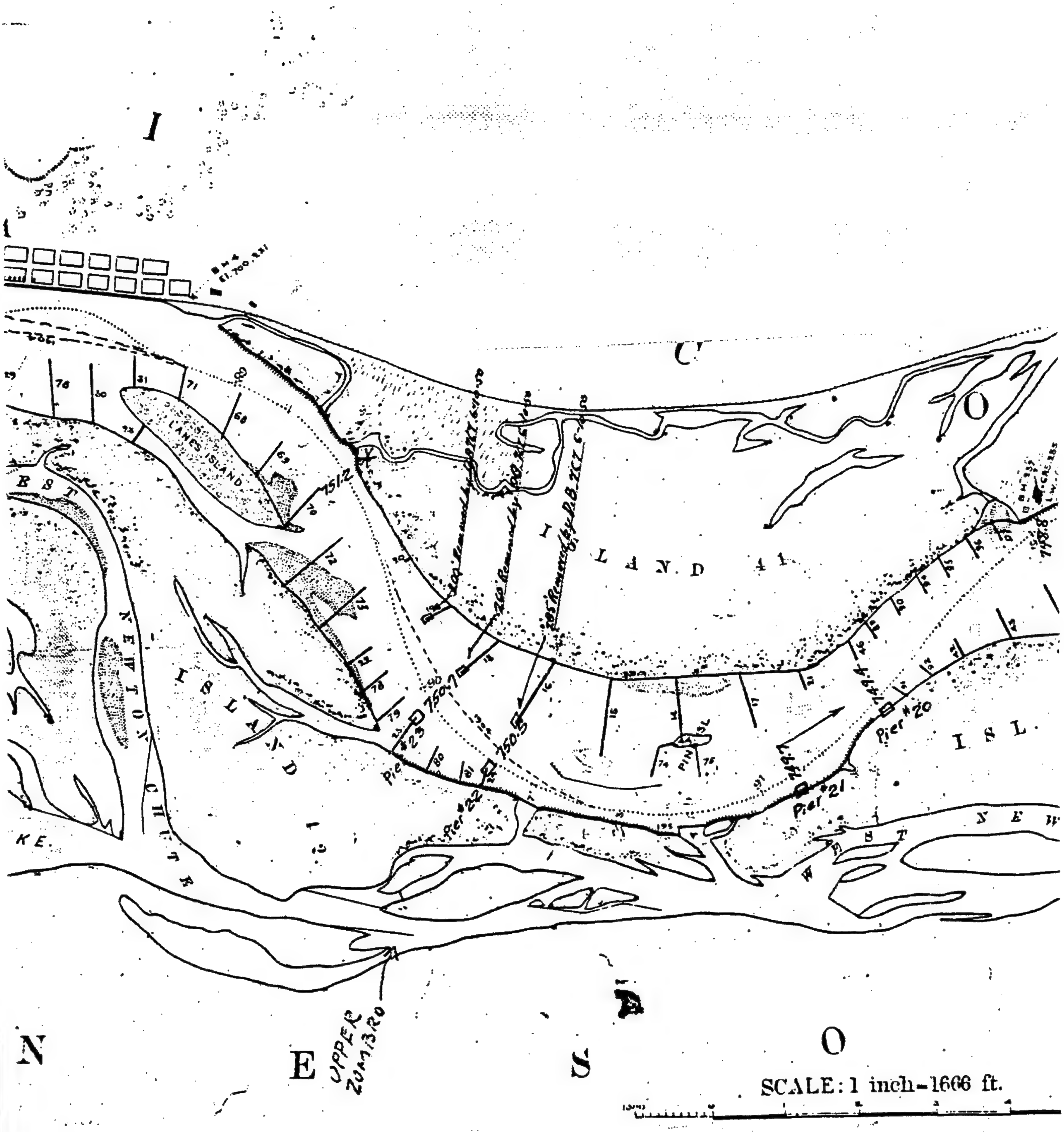


Tile 17

Plate 3. Pool 5 Dredge Cuts



14. 15.
W
I
Lock & Dam No. 4
ALMA
ISLAND 39
ISLAND 37
Dredged 1933
752.8
Dredged
ISLAND 40.
LANES ISLAND
WEST
NEWTON
CHUTE
ISLAND
LAKE
Earth Dike
PILE LAKE
I
N
N
E



LANES ISLAND
I L A N D 41
NEWTON CHUTE
I S L A N D
751.2
750.7
750.5
749.7
749.4
748.8
Pier #23
Pier #22
Pier #21
Pier #20
PIN ISL
UPPER ZUMBRO
N E S O
SCALE: 1 inch-1666 ft.

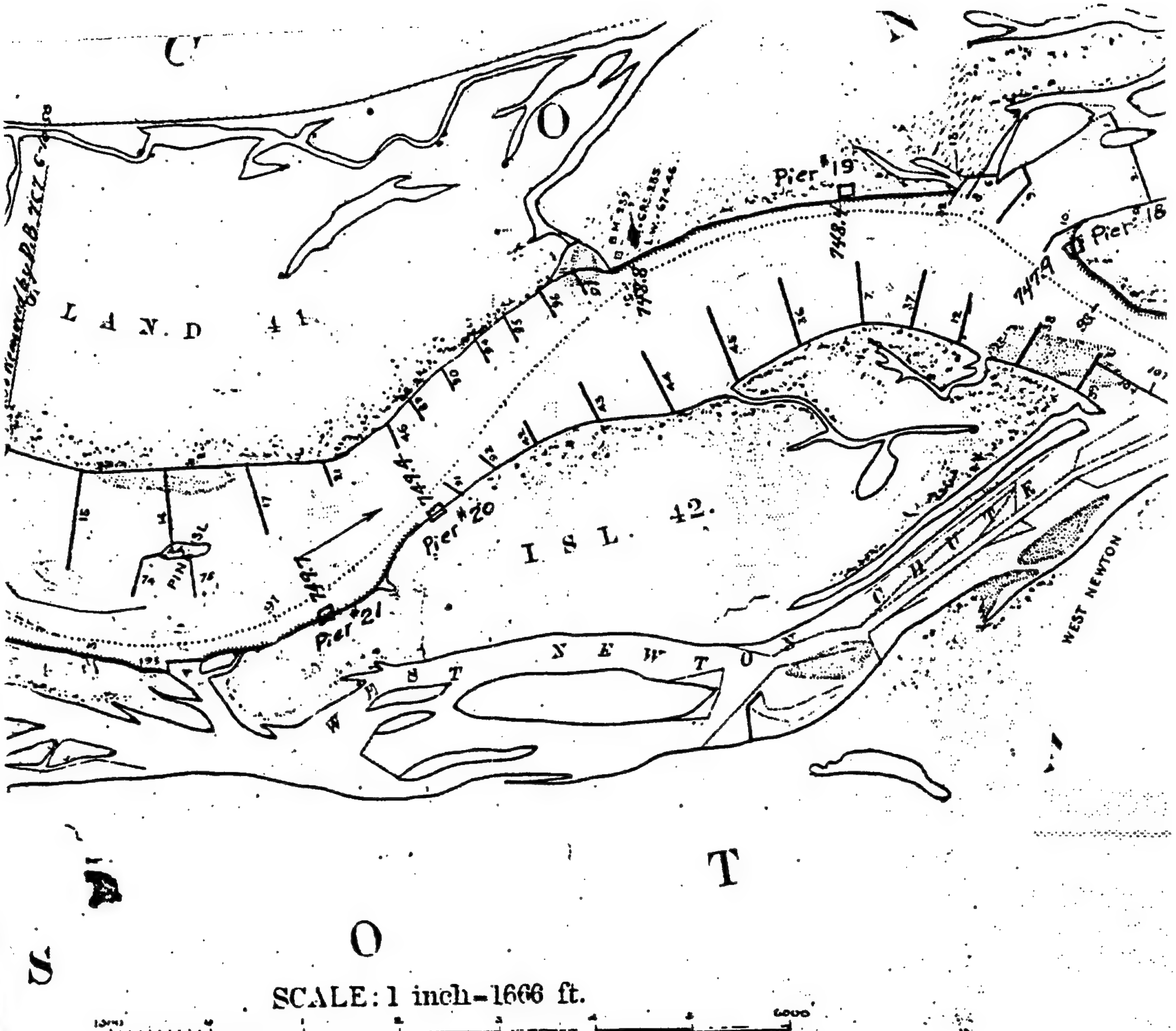
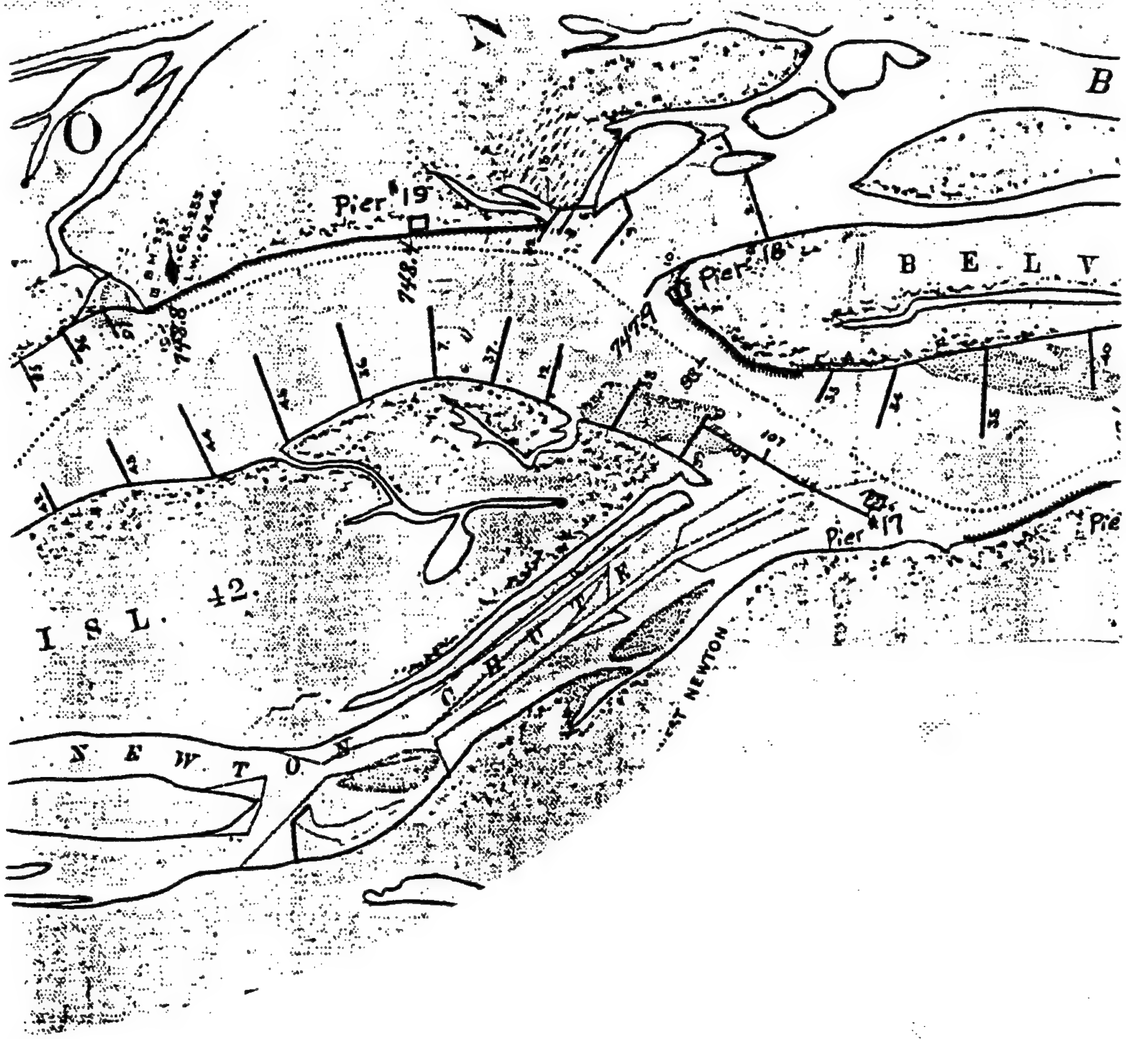
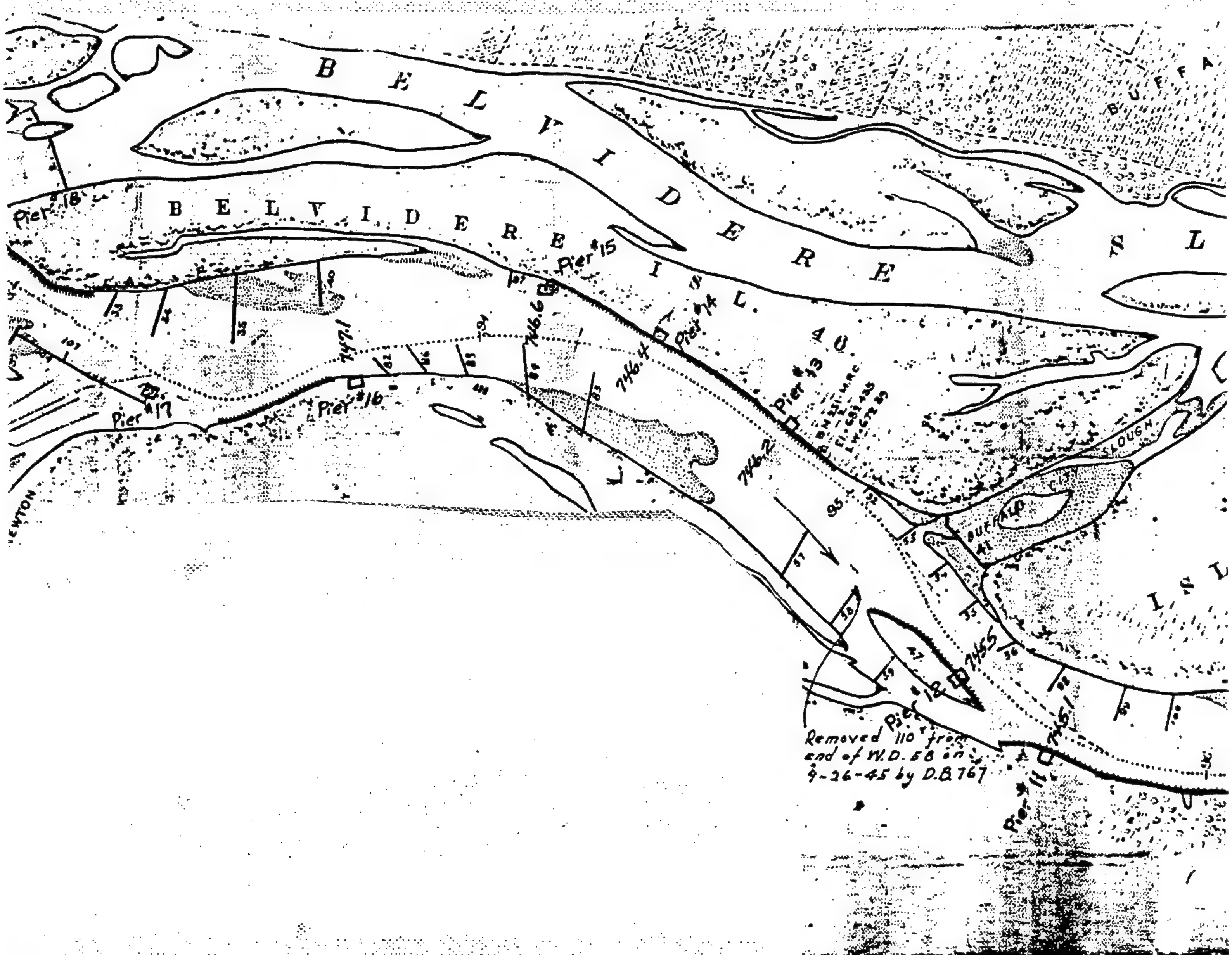

LAND 41
ISL. 42.
WEST NEWTON CHUTE
Pier #19
Pier #18
Pier #20
Pier #21
748.4
747.9
748.8
749.4
749.7
WEST NEWTON
SCALE: 1 inch-1666 ft.

Plate 4a



Pier 19
Pier 18
Pier 17
B E L V
ISL. 42
NEWTON
CHUTE


BELVIDERE
BELVIDERE ISL.
Pier 18
Pier #15
Pier #14
Pier #13
Pier #17
Pier #16
Pier 12
Pier #11
747.1
746.6
746.4
746.2
745.5
745.1
40
BUFFALO
SLOUGH
Removed 110' from
end of W.D. 58 on
9-26-45 by D.B. 767

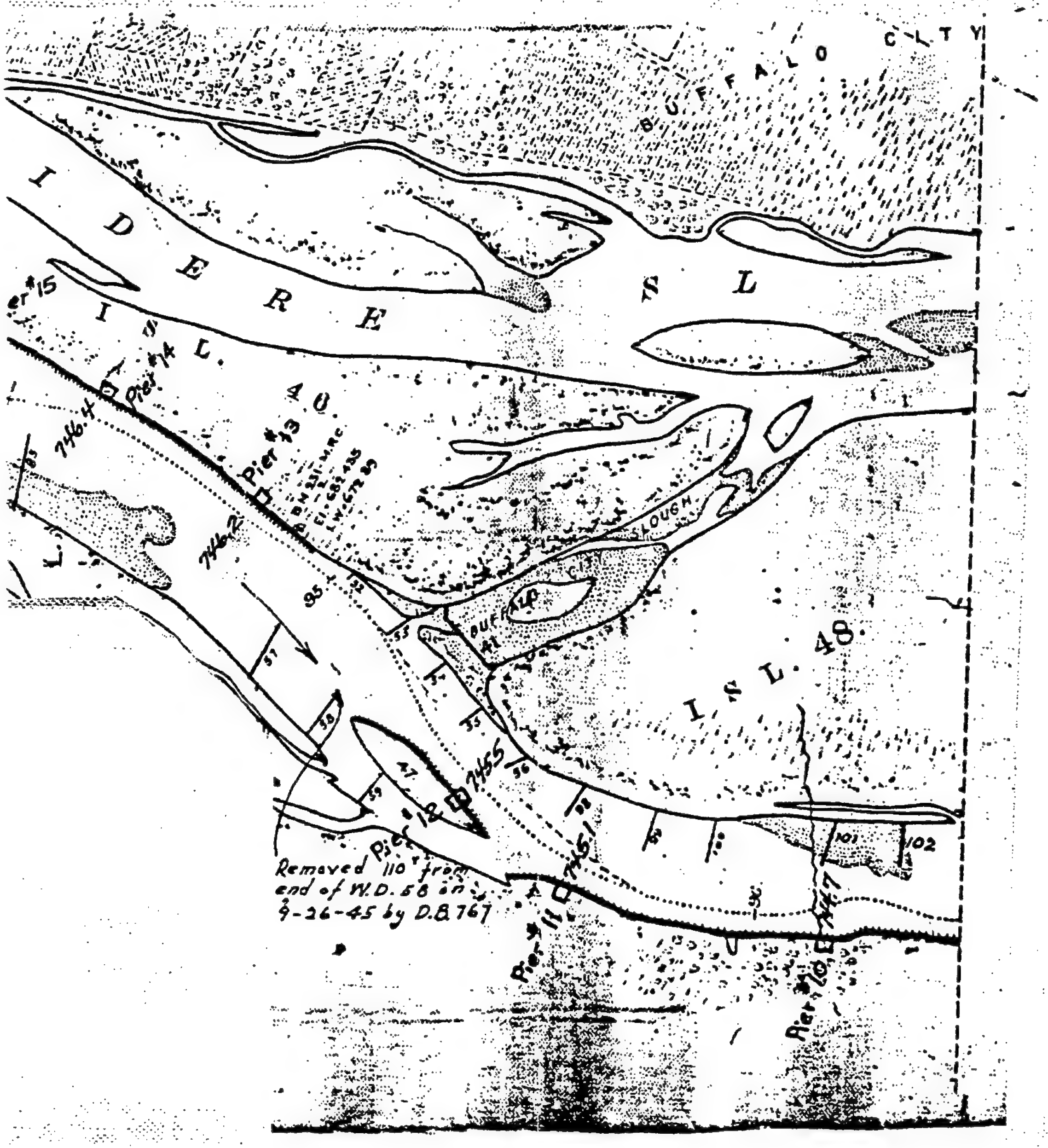
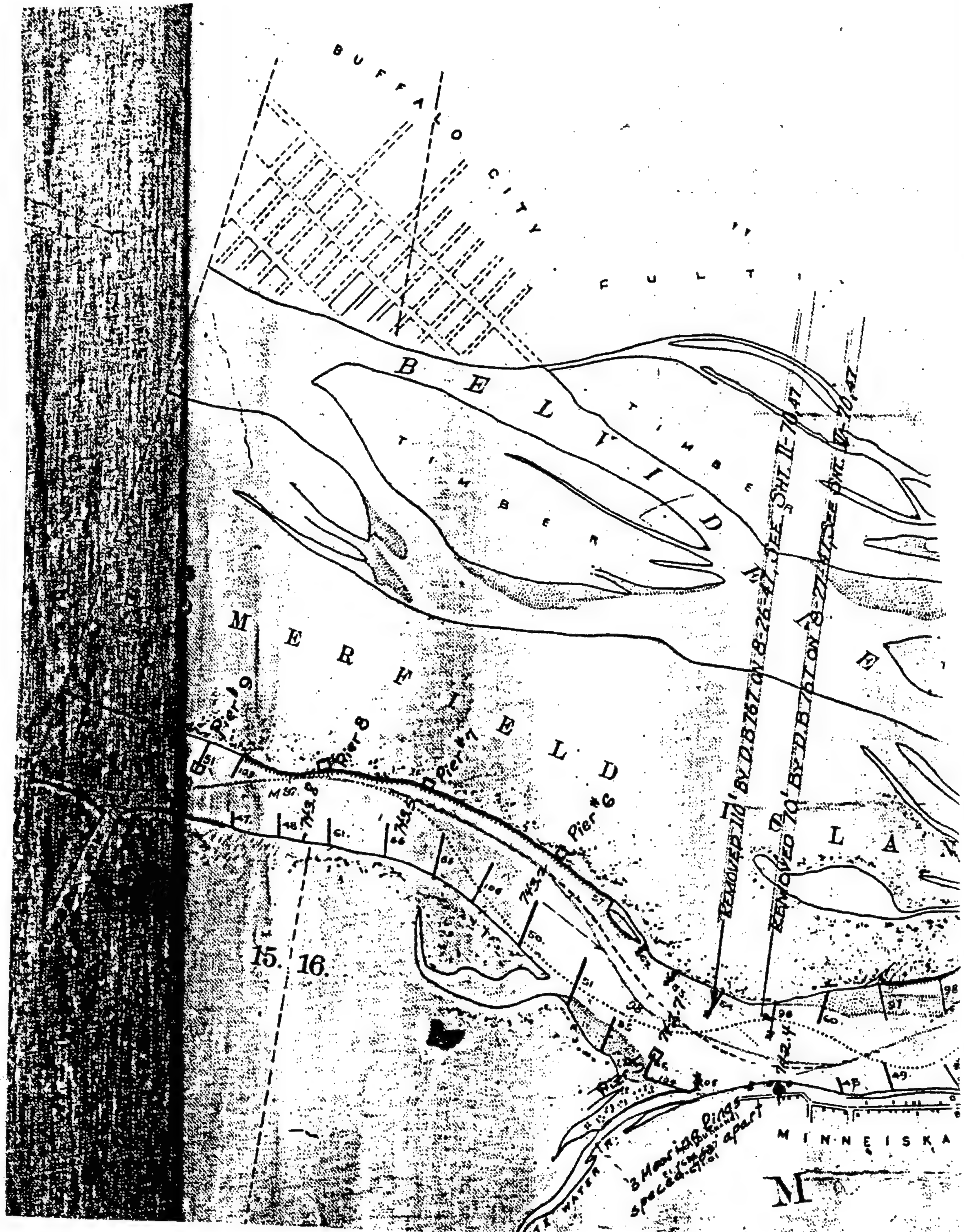
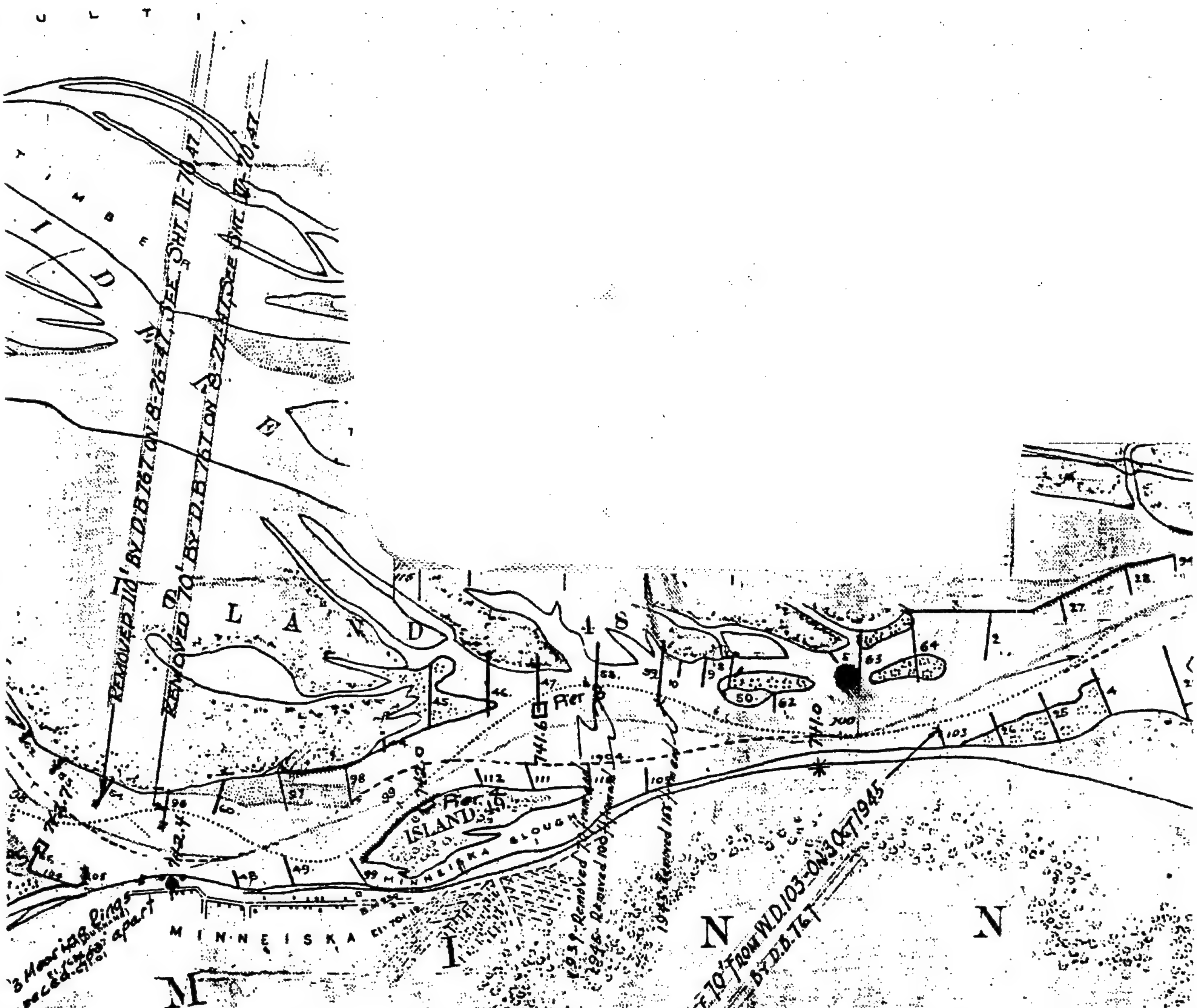

BUFFALO CITY
ISL. 48
Pier #14
Pier #13
746.4
746.2
SLOUGH
Pier #12
745.5
Pier #11
745.1
Pier #10
Removed 110' from end of W.D. 58 on 9-26-45 by D.B. 767

Plate 4b


BUFFALO CITY
FULT
BELVIDERE
TIMBER
TIMBER
MERFIELD
Pier 9
Pier 8
Pier 7
Pier #6
15.
16.
REMOVED 110' BY D.B.767 ON 8-26-47, SEE SHT. II-70-47
REMOVED 70' BY D.B.767 ON 8-27-47, SEE SHT. II-70-47
LA
3 Moor'g Rings
spaced apart
MINNEISKA
WATER ST.
M



REMOVED 110' BY D.B.T&T. ON 8-26-47. SEE SHT. II-70-47
REMOVED 70' BY D.B.T&T. ON 8-27-47. SEE SHT. II-70-47
ISLAND 19
MINNEISKA SLOUGH
MINNEISKA
CUT-OFF 70' FROM W.D. 103 - ON 3 OCT 1945 BY D.B.T&T.
3 Mooring Rings spaced apart
741.6
741.0
742.4

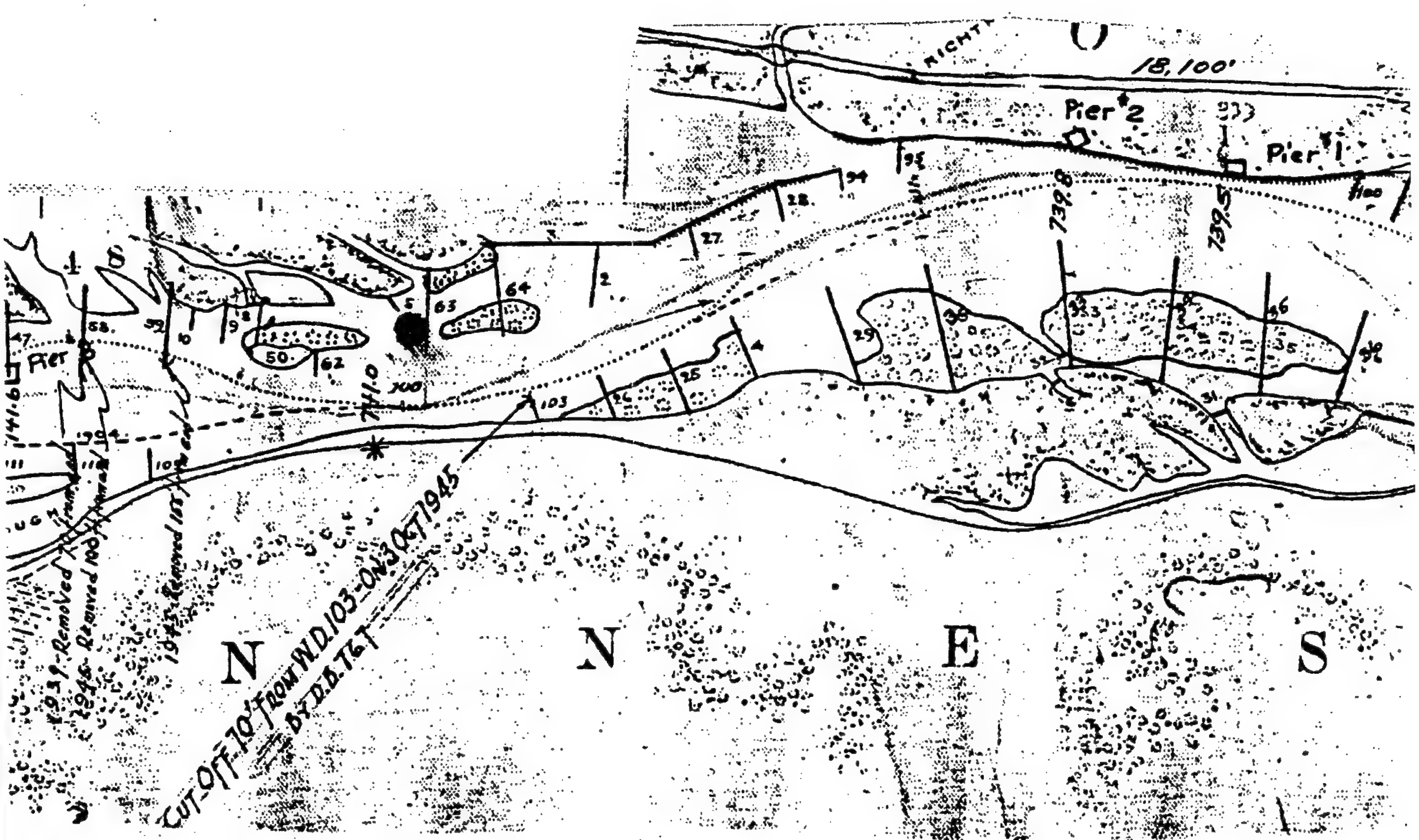
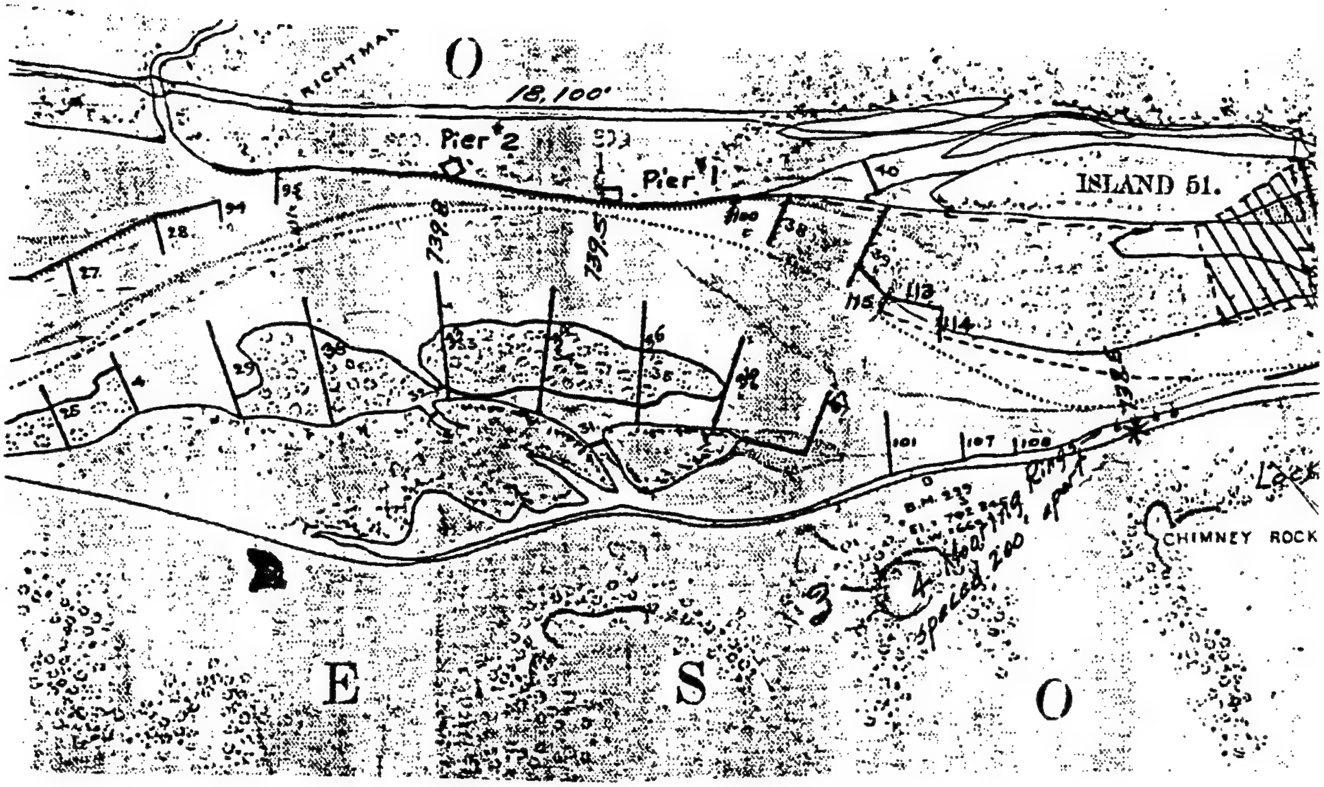
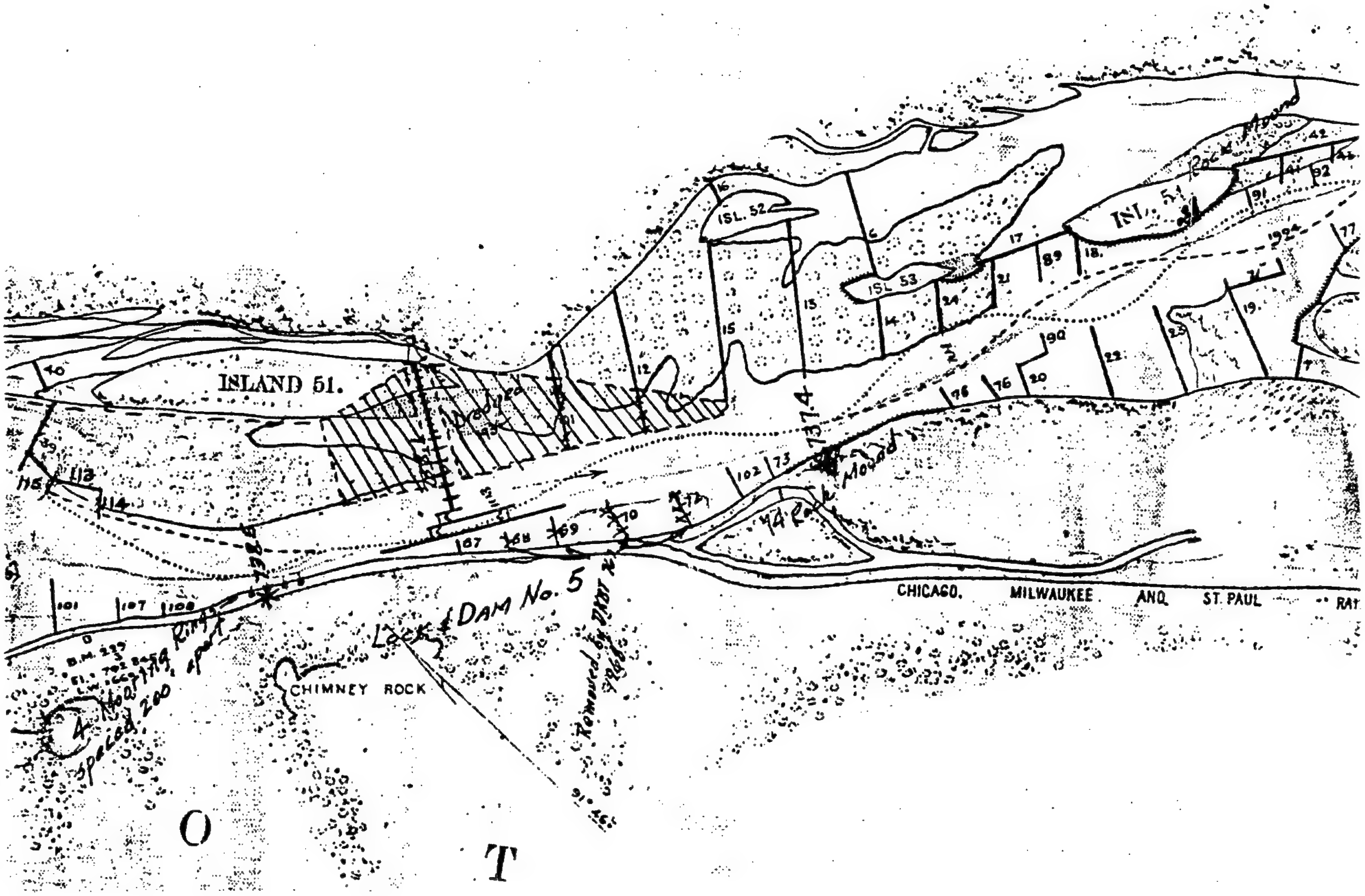

18,100'
Pier #2
Pier #1
739.8
739.5
741.0
Pier
CUT-OFF 70' FROM W.D.103-ON 3 OCT 1945
BY D.D.T&T
1939-Removed
1946-Removed 100'
1945-Removed 185'
N
N
E
S

Plate 4c


O
RICHTMAN
18,100'
Pier #2
Pier #1
ISLAND 51.
739.8
739.5
CHIMNEY ROCK
Lock
4 Mooring Rings spaced 200' apart
E
S
O


ISLAND 51.
ISL. 52
ISL 53
ISL. 54
Rock Mound
Rock Mound
74 Rock Mound
Lock & Dam No. 5
CHIMNEY ROCK
CHICAGO. MILWAUKEE AND ST. PAUL
737.4
Dredged
4 Mooring Rings spaced 200 apart
O
T

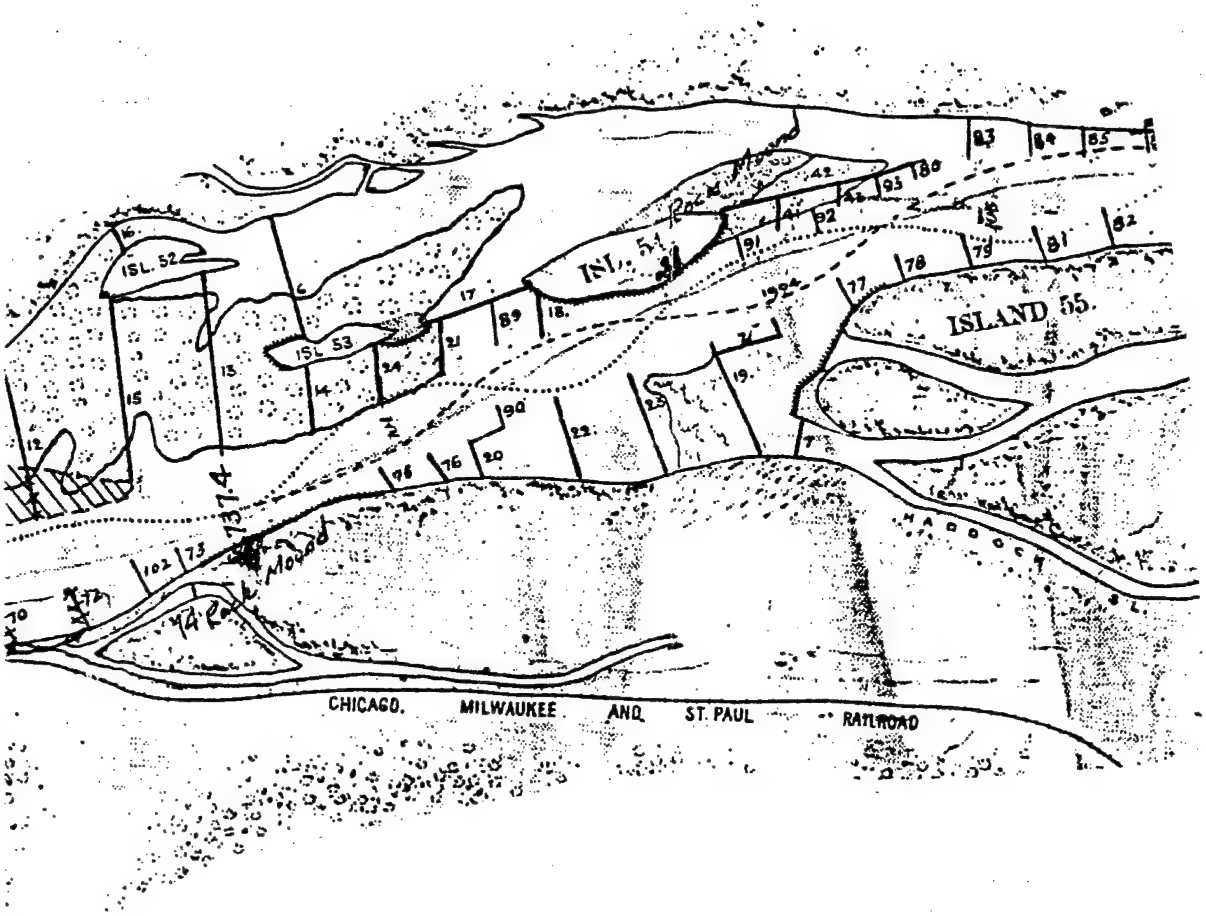
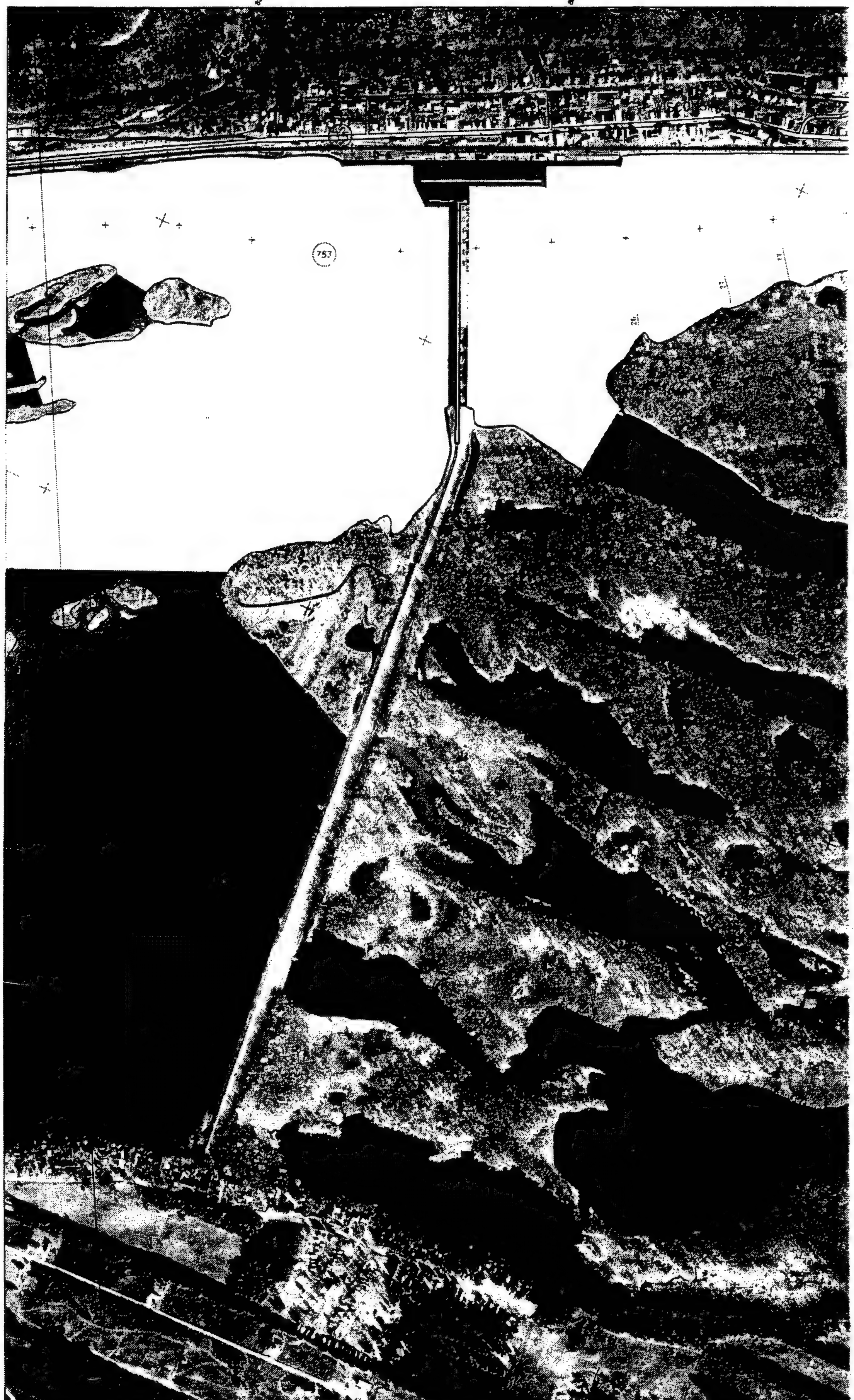

ISL. 52
ISL 53
ISL. 54
ISLAND 55.
Rock Mound
CHICAGO. MILWAUKEE AND ST. PAUL RAILROAD
HADDOCK SL.
737.4

Plate 4d



T 110 N, R 10 W / T 110 N, R 9 W

MARKHURD

1

HUB

Surveys

Gage R

Process
Unit Ch
Channe

Channel
Chief, W
Project M

Remarks

HUB	AZIMUTH	DISTANCE	COORDINATES		ELEVATION
			NORTH	EAST	
LD 4 DGPS	3/4 I.P.		818,932.66	3,168,915.32	

NOTE

CONTROL SURVEYS FURNISHED BY ENVIROSCIENCE, INC.

THIS MAP MEETS NATIONAL MAP ACCURACY STANDARDS

COORDINATES BASED ON MINNESOTA STATE PLANE GRID SYSTEM, SOUTH ZONE, N.A. DATUM OF [illegible].

DATE OF PHOTOGRAPHY: NOV., [illegible]

Surveyed By: ________ Launch __________ Acres ____

Gage Reading: ______ Location: ________ UMR

Individual	Initials	Date
Processor	____	____
Unit Chief	____	____
Channel Maintenance Coordinator	____	____

____ 1. No Action
____ 2. Resurvey ______________
____ 3. Dredge Area As Shown

Channel Maintenance Coordinator	____	____
Chief, Waterways Section	____	____
Project Manager	____	____

Remarks ______________________

MILE 753.0 LCP 666.5
MILE 752.0 LCP 660.0

UPPER MISSISSIPPI RIVER IMPROVEMENT
ST. PAUL, MINN. DISTRICT

L/D NO. 4 - ALMA LOWER LIGHT

MILE 751.0 TO 753.3 | SCALE 1"=400' | SHEET 4-01

Plate 5a

MARKHURD

HUB	AZIMUTH	DIS

Surveyed By: ______

Gage Reading: ______

Individual

Processor
Unit Chief
Channel Maintenance C

_____ 1. No Action
_____ 2. Resurvey _____
_____ 3. Dredge Area A

Channel Maintenance Co
Chief, Waterways Section
Project Manager

Remarks: ______

UPPER MI

MILE 749.5 TO

HUB	AZIMUTH	DISTANCE	COORDINATES		ELEVATION
			NORTH	EAST	

NOTE

CONTROL SURVEYS FURNISHED BY ENVIROSCIENCE, INC.

THIS MAP MEETS NATIONAL MAP ACCURACY STANDARDS

COORDINATES BASED ON MINNESOTA STATE PLANE GRID SYSTEM, SOUTH ZONE, N.A. DATUM OF 1927.

DATE OF PHOTOGRAPHY: NOV. 19[illegible]

Surveyed By: ________ **Launch** ________ **Acres** ____

Gage Reading: ______ **Location:** ________ **UMR**

Individual	Initials	Date
Processor	____	____
Unit Chief	____	____
Channel Maintenance Coordinator	____	____

____ 1. No Action
____ 2. Resurvey ________________
____ 3. Dredge Area As Shown

Channel Maintenance Coordinator	____	____
Chief, Waterways Section	____	____
Project Manager	____	____

Remarks: ________________

MILE 751.0 LCP 660.0
MILE 749.0 LCP 660.0

UPPER MISSISSIPPI RIVER IMPROVEMENT
ST. PAUL DISTRICT

UPPER ZUMBRO

MILE 749.5 TO 751.3	SCALE 1"=400'	SHEET 5-07

Plate 5b

MARKHURD

T 21N , R 13 W / T 21N , R 12 W

HUB	A

Surveyed E

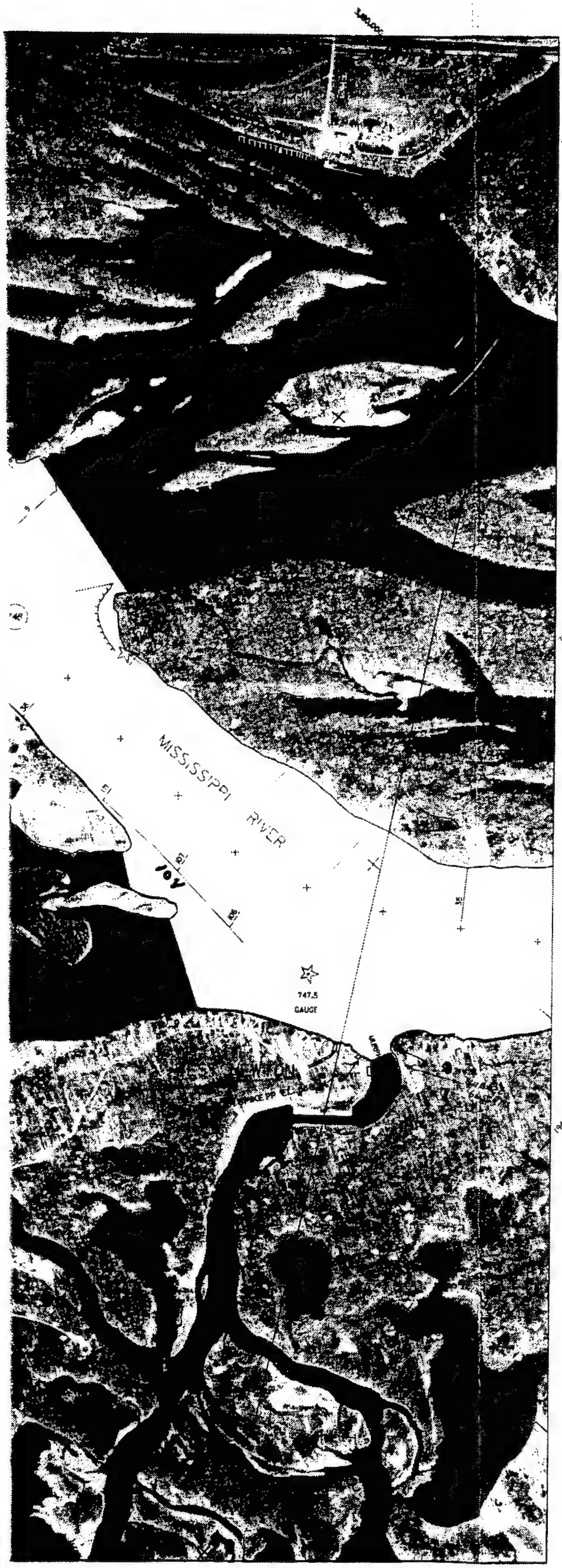
Gage Read

Processor
Unit Chief
Channel M

1
2
3

Channel Ma
Chief, Wate
Project Man

Remarks



HUB	AZIMUTH	DISTANCE	COORDINATES		ELEVATION
			NORTH	EAST	

NOTE

CONTROL SURVEYS FURNISHED BY ENVIROSCIENCE, INC.

THIS MAP MEETS NATIONAL MAP ACCURACY STANDARDS

COORDINATES BASED ON MINNESOTA STATE PLANE GRID SYSTEM, SOUTH ZONE, N.A. DATUM OF 1983.

DATE OF PHOTOGRAPHY: NOV., 1992

Surveyed By:________ Launch__________ Acres _____

Gage Reading________ Location:________ UMR

Individual	Initials	Date
Processor	____	____
Unit Chief	____	____
Channel Maintenance Coordinator	____	____

_____ 1. No Action

_____ 2. Resurvey ____________________

_____ 3. Dredge Area As Shown

Channel Maintenance Coordinator	____	____
Chief, Waterways Section	____	____
Project Manager	____	____

Remarks: ______________________________

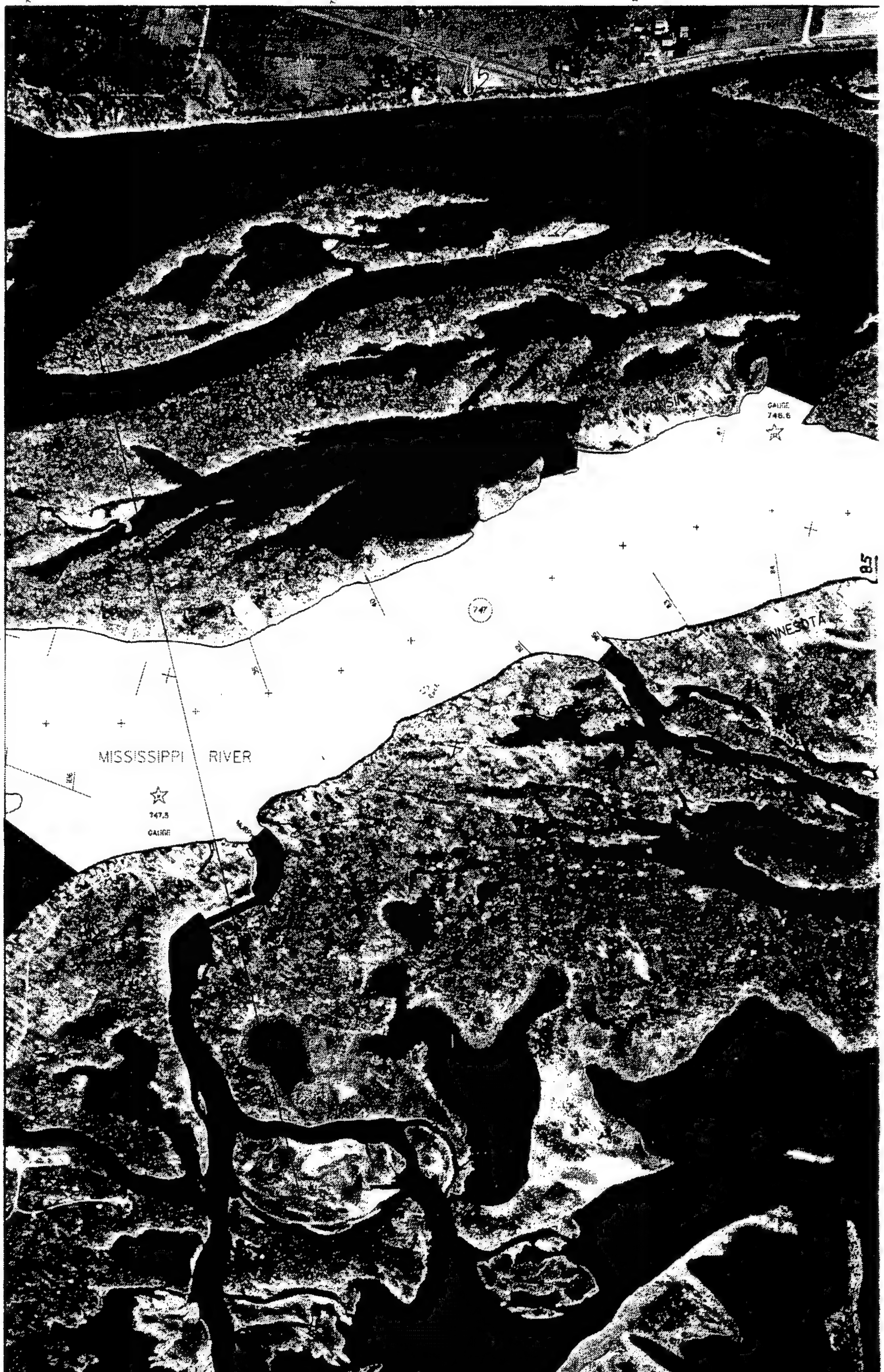
MILE 749.0 LCP 660.0
MILE 748.0 LCP 660.0

UPPER MISSISSIPPI RIVER IMPROVEMENT
ST. PAUL DISTRICT

MULE BEND

MILE 747.5 TO 749.7	SCALE 1"=400'	SHEET 5-06

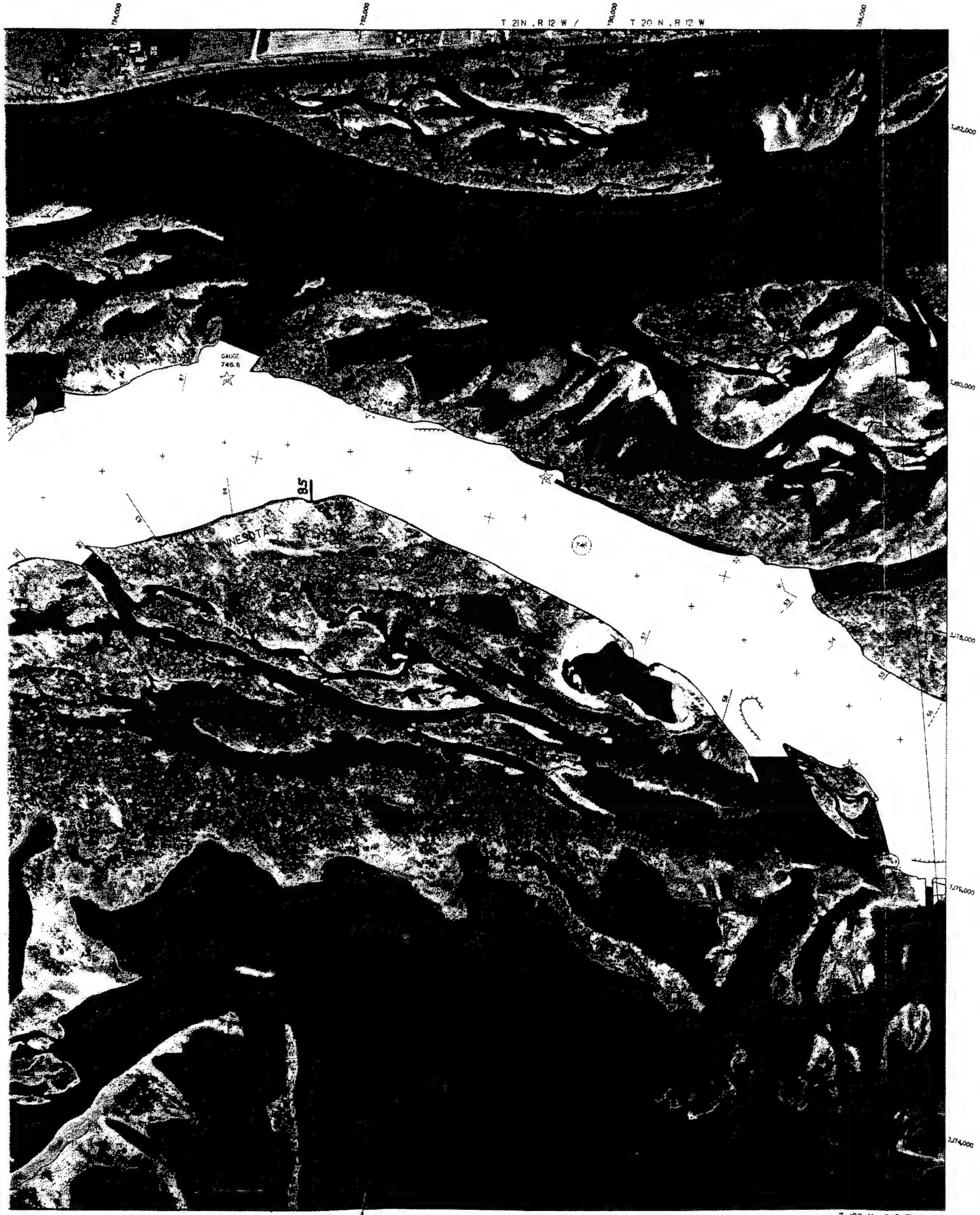
Plate 5c

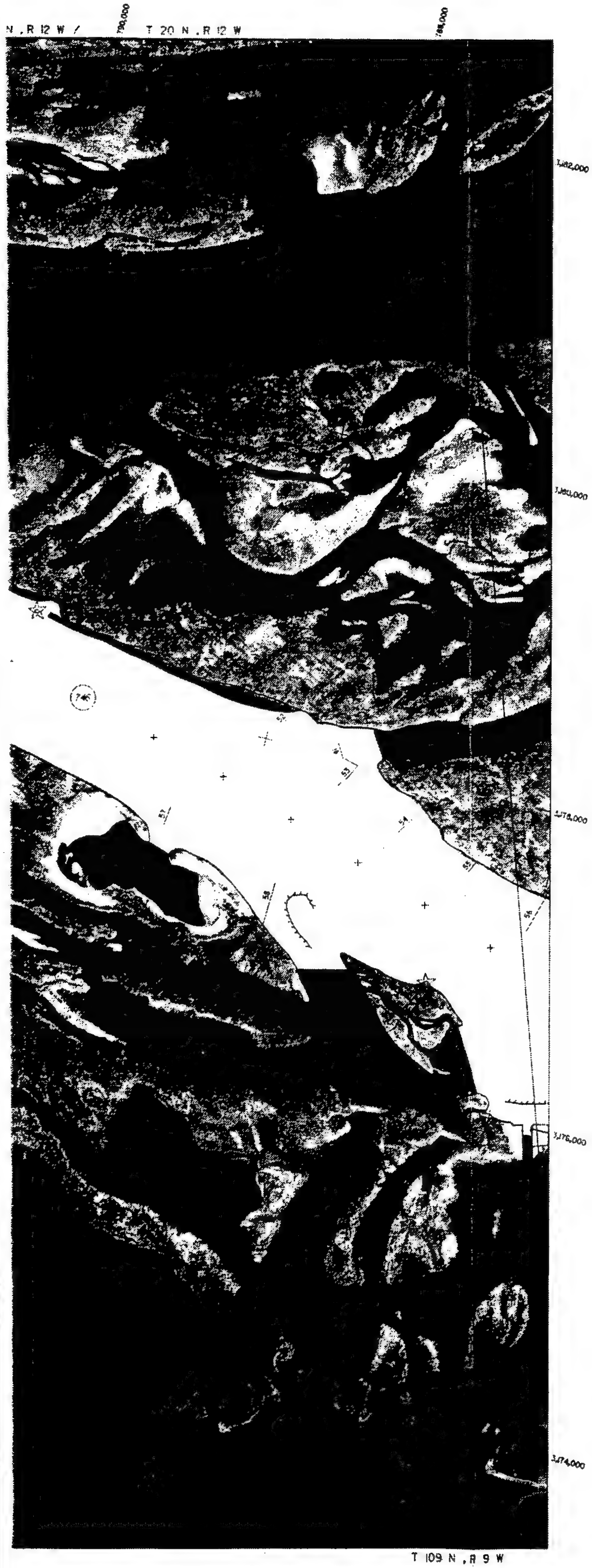


798,000
796,000
794,000
T 21N . R 13 W / T 21N . R 12 W
WISCONSIN
GAUGE
748.6
747
85
MINNESOTA
MISSISSIPPI RIVER
747.5
GAUGE

MARKHURD

1


194,000
192,000
T 21N, R 12 W
190,000
T 20 N, R 12 W
188,000
GAUGE
746.6
85
MINNESOTA
T 109 N, R 9 W



HUB	AZIMUTH	DISTANCE	COORDINATES		ELEVATION
			NORTH	EAST	

NOTE

CONTROL SURVEYS FURNISHED BY ENVIROSCIENCE, INC.

THIS MAP MEETS NATIONAL MAP ACCURACY STANDARDS

COORDINATES BASED ON MINNESOTA STATE PLANE GRID SYSTEM, SOUTH ZONE, N.A. DATUM OF 1983.

DATE OF PHOTOGRAPHY: NOV., 1992

Surveyed By:________ **Launch**________ **Acres** ____

Gage Reading ______ **Location:**________ **UMR**

Individual	Initials	Date
Processor	____	____
Unit Chief	____	____
Channel Maintenance Coordinator	____	____

____ 1. No Action
____ 2. Resurvey ____________
____ 3. Dredge Area As Shown

Channel Maintenance Coordinator	____	____
Chief, Waterways Section	____	____
Project Manager	____	____

Remarks ________________

MILE 747.0 LCP 659.9
MILE 746.0 LCP 659.9

UPPER MISSISSIPPI RIVER IMPROVEMENT ST. PAUL DISTRICT		
FISHER ISLAND		
MILE 745.5 TO 747.2	SCALE 1"=400'	SHEET 5-05

Plate 5d

MARKHURD

Plate 5f

T 109 N , R 9 W

HUB	AZIMUTH
R-743.7	F.F.
R-743.9	F.P.
R-744.3	F.P.
L-743.5	
L-744.2	
L-744.4	

Surveyed By ____

Gage Reading ____

Indivi

Processor
Unit Chief
Channel Maintenan

____ 1. No Actio
____ 2. Resurvey
____ 3. Dredge A

Channel Maintenanc
Chief, Waterways Se
Project Manager

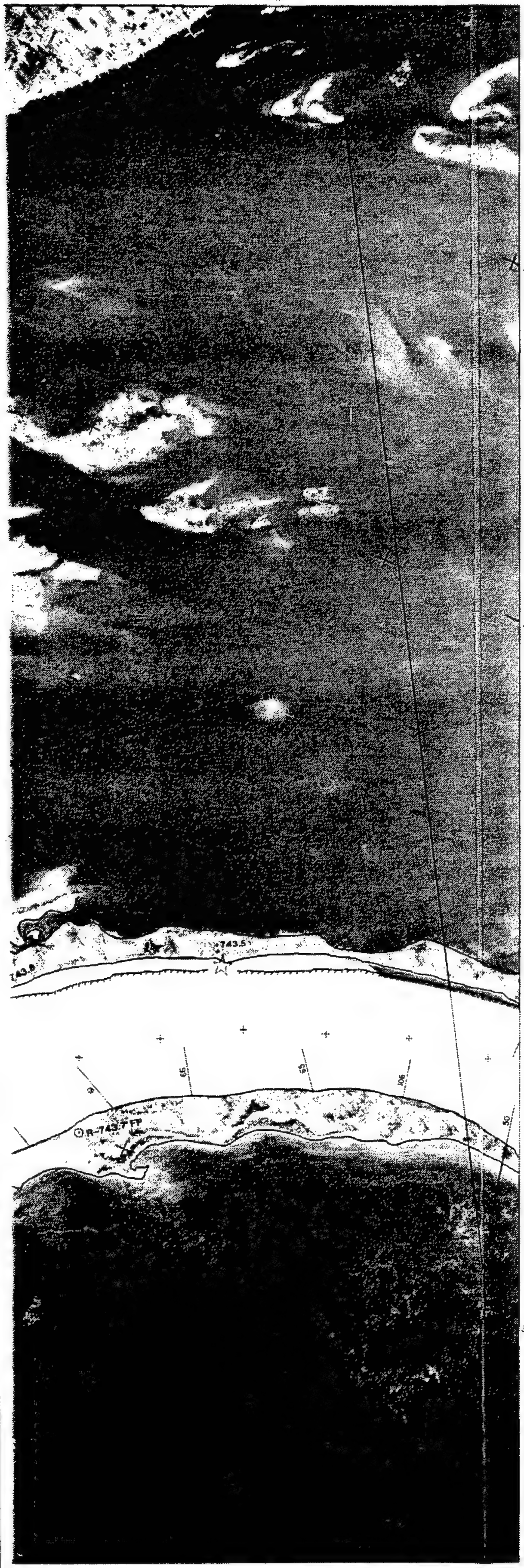
Remarks: ____

UPP

LC

MILE 743.

Plate 5f



T 109 N , R 9 W

HUP	AZIMUTH	DISTANCE	COORDINATES		ELEVATION
			NORTH	EAST	
R-743.7	F.P.		778,283.95	3,178,313.09	
R-743.9	F.P.		779,420.28	3,179,203.59	
R-744.3	F.P.		780,494.42	3,177,932.90	
L-743.5		S-18	779,141.11	3,180,481.37	
L-744.2		S-19	780,182.11	3,179,488.52	
L-744.4		S-20	781,575.02	3,179,755.54	

NOTE

CONTROL SURVEYS FURNISHED BY ENVIROSCIENCE, INC.

THIS MAP MEETS NATIONAL MAP ACCURACY STANDARDS

COORDINATES BASED ON MINNESOTA STATE PLANE GRID SYSTEM, SOUTH ZONE, N.A. DATUM OF 1927.

DATE OF PHOTOGRAPHY: NOV. 1992

Surveyed By: ________ Launch ________ Acres ____

Gage Reading ________ Location ________ UMR

Individual	Initials	Date
Processor		
Unit Chief		
Channel Maintenance Coordinator		

____ 1. No Action
____ 2. Resurvey ________
____ 3. Dredge Area As Shown

Channel Maintenance Coordinator		
Chief, Waterways Section		
Project Manager		

Remarks: ________

MILE 745.0 LCP 659.8
MILE 744.0 LCP 659.8

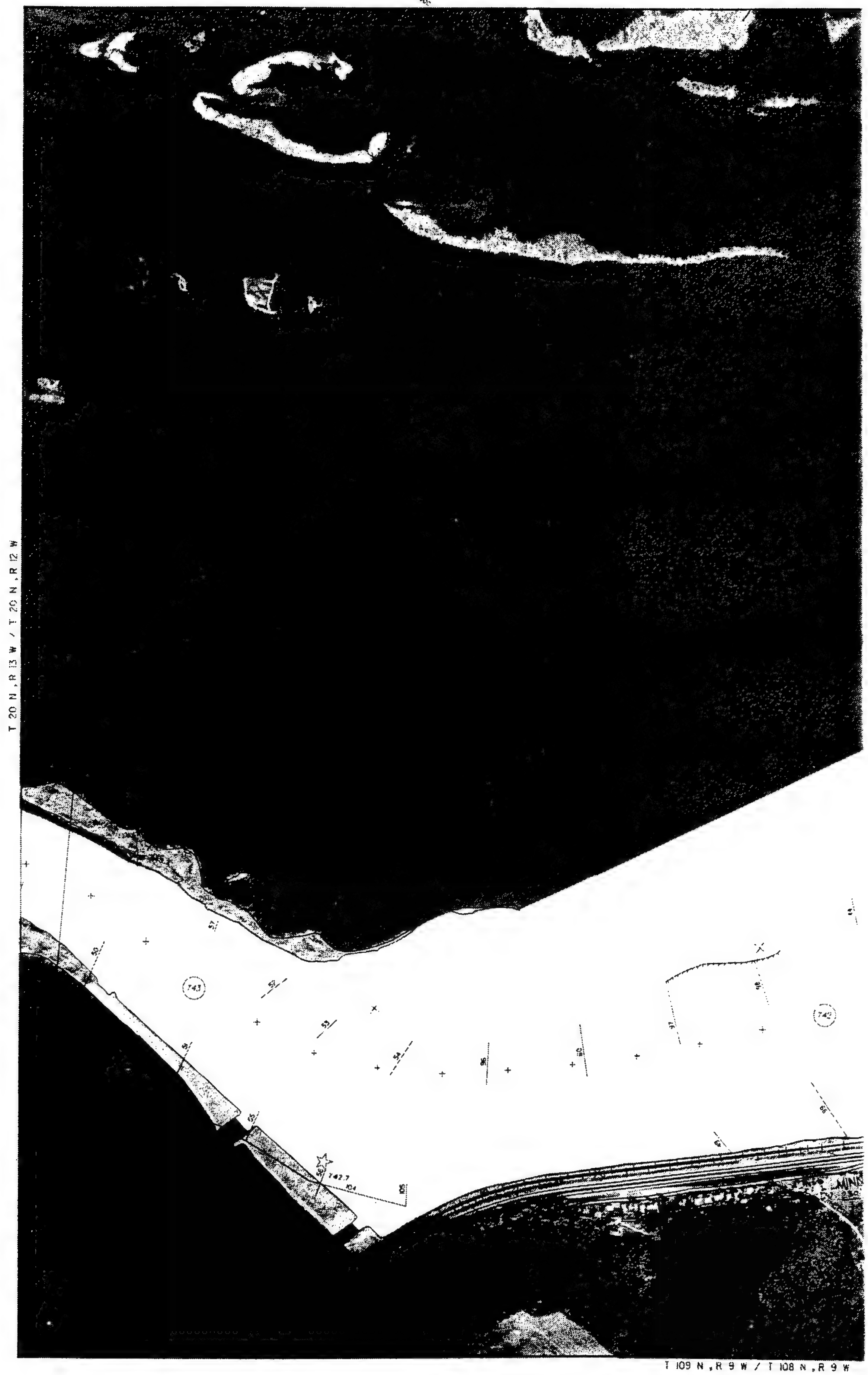
UPPER MISSISSIPPI RIVER IMPROVEMENT
ST. PAUL DISTRICT

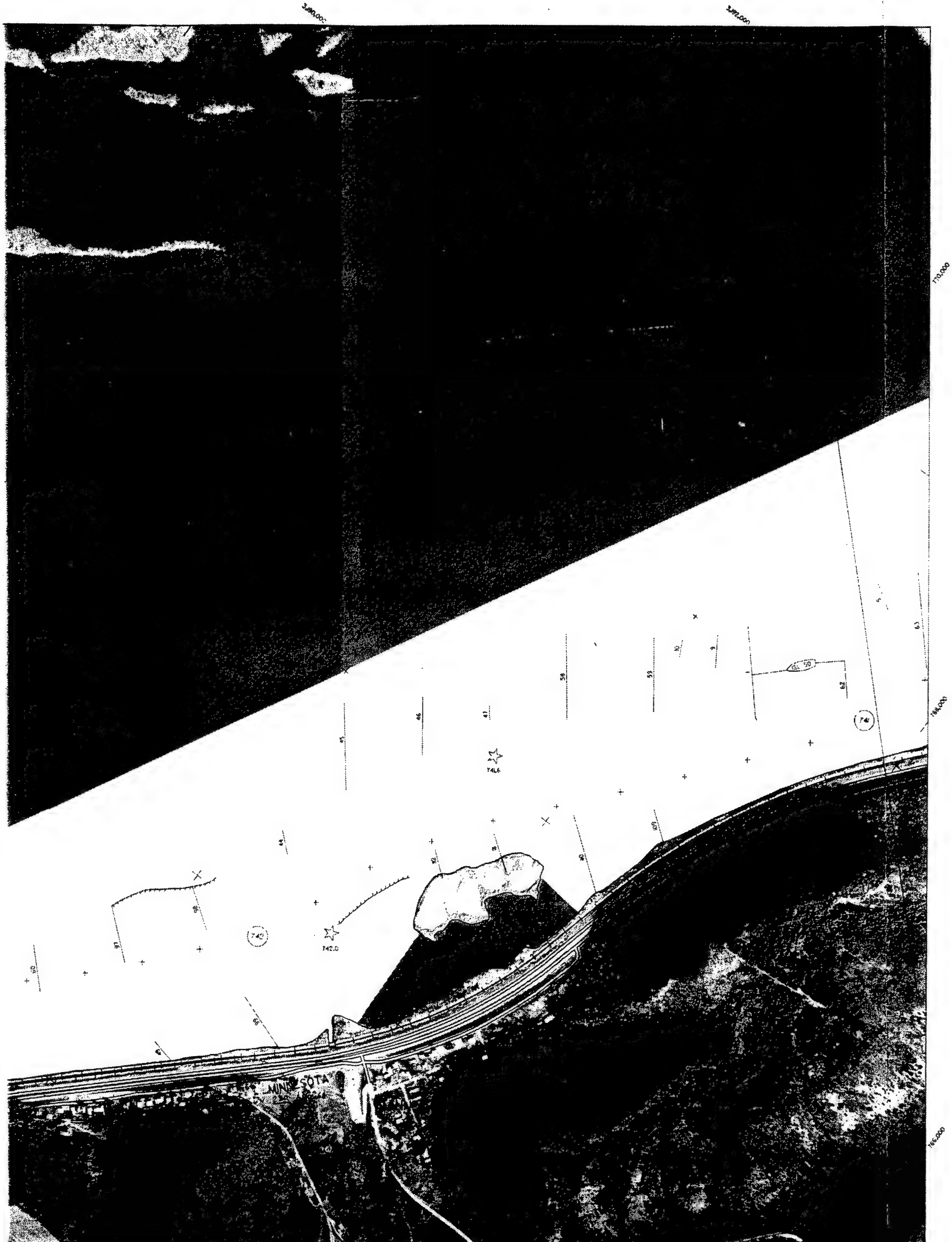
LOWER ZUMBRO - SOMERFIELD ISLAND

MILE 743.5 TO 745.3 | SCALE 1"=400' | SHEET 5-04

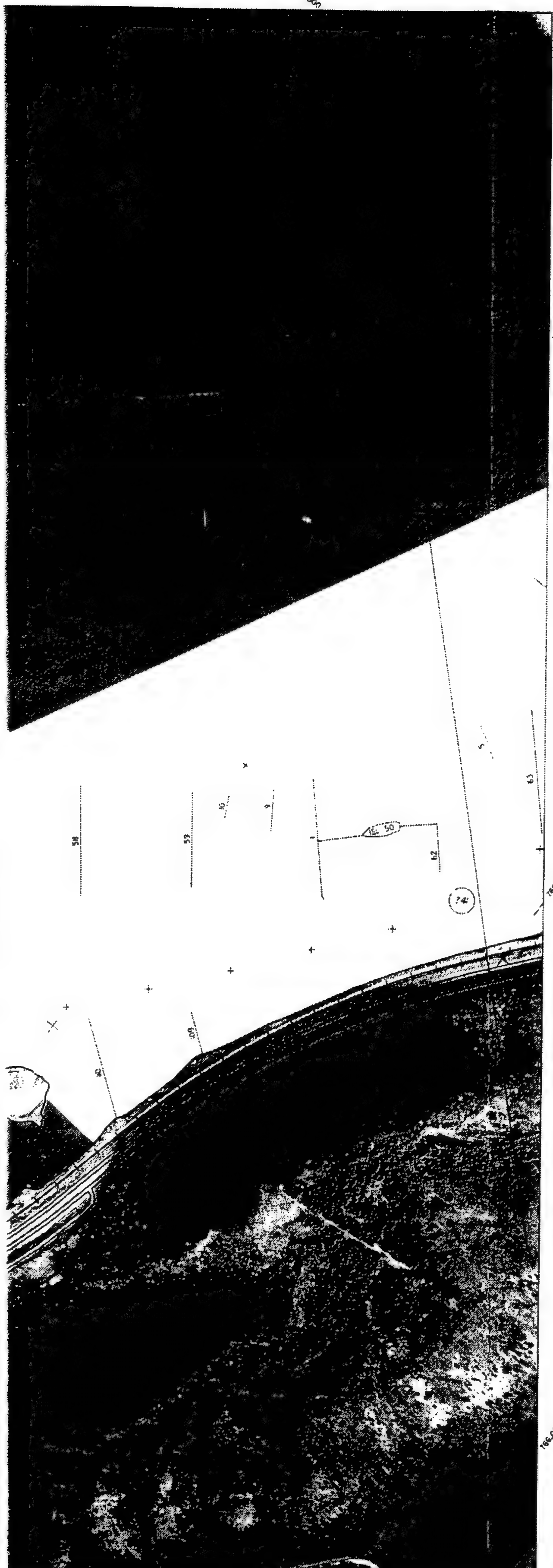
3

Plate 5e


T 20 N, R 13 W / T 20 N, R 12 W
743
742
742.7
T 109 N, R 9 W / T 108 N, R 9 W



T 109 N , R 9 W / T 108 N , R 9 W



HUB	AZIMUTH	DISTANCE	COORDINATES		ELEVATION
			NORTH	EAST	

NOTE

CONTROL SURVEY FURNISHED BY ENVIROSCIENCE, INC.

THIS MAP MEETS NATIONAL MAP ACCURACY STANDARDS.

COORDINATES BASED ON MINNESOTA STATE PLANE GRID SYSTEM, SOUTH ZONE, N.A. DATUM OF 1983.

DATE OF PHOTOGRAPHY: NOV., [illegible]

Surveyed By:_________ **Launch**___________ **Acres** _____

Gage Reading _______ **Location:**__________ **UMR**

Individual	Initials	Date
Processor		
Unit Chief		
Channel Maintenance Coordinator		

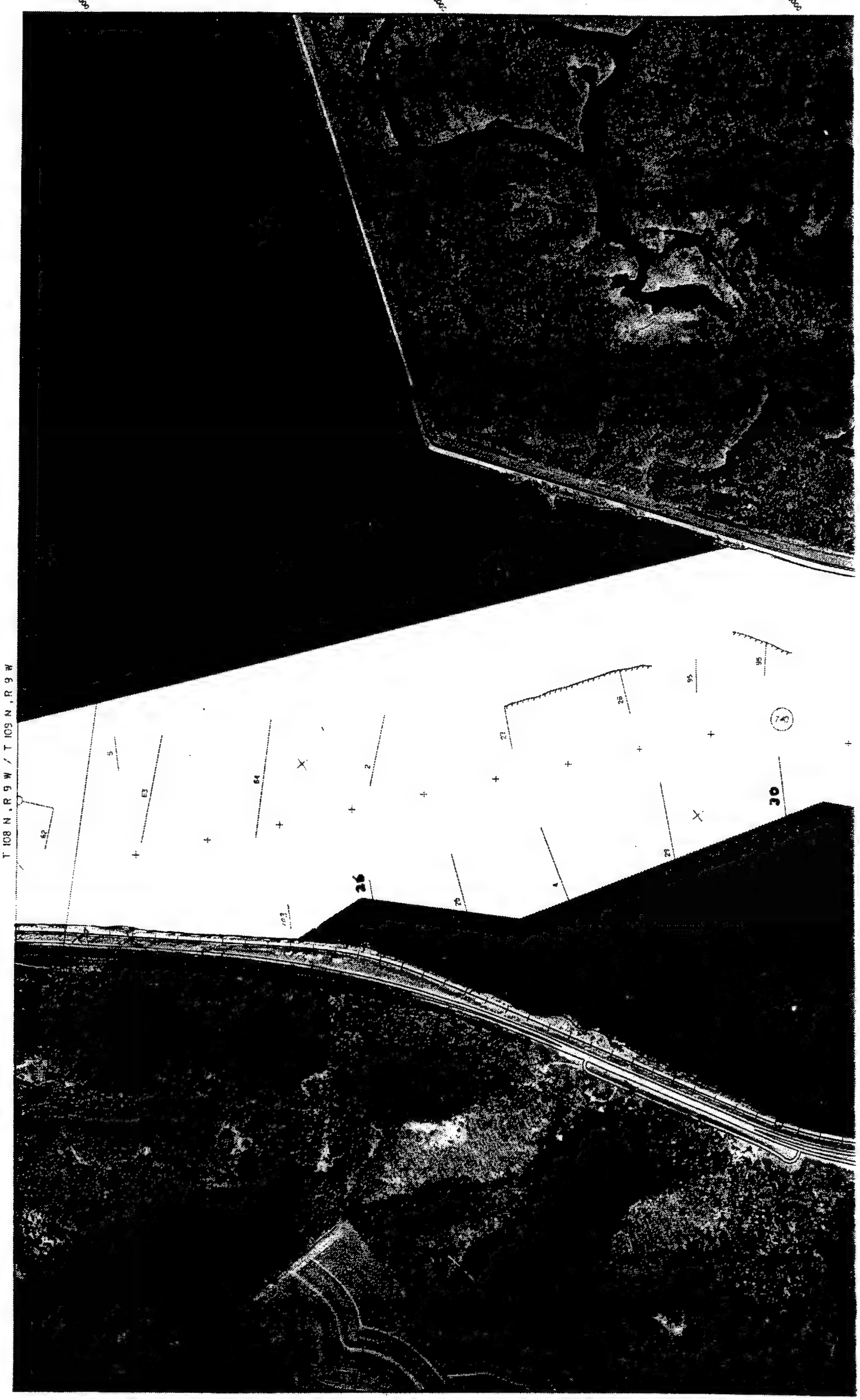
_____ **1. No Action**
_____ **2. Resurvey** ______________________
_____ **3. Dredge Area As Shown**

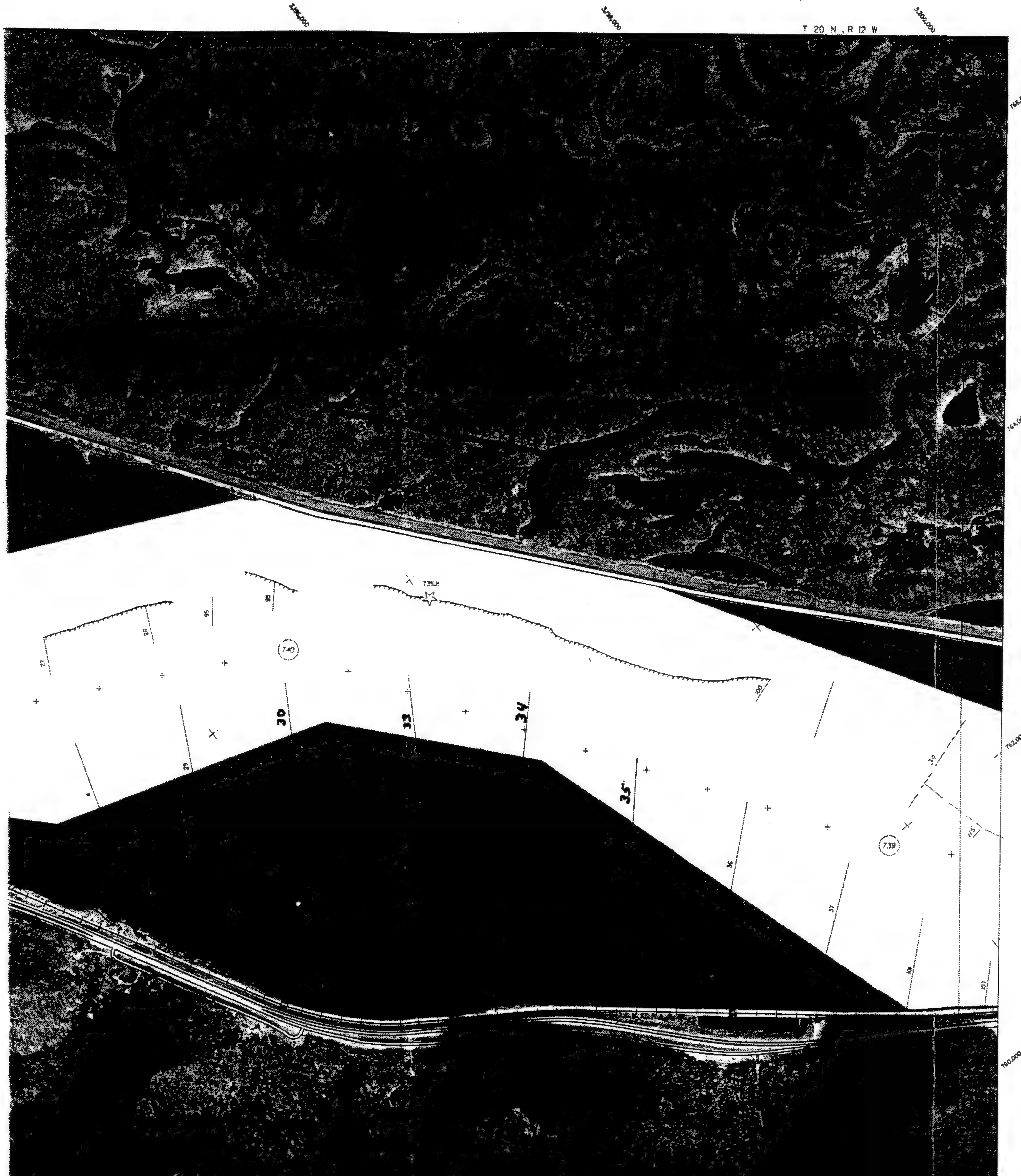
Channel Maintenance Coordinator		
Chief, Waterways Section		
Project Manager		

Remarks ______________________________

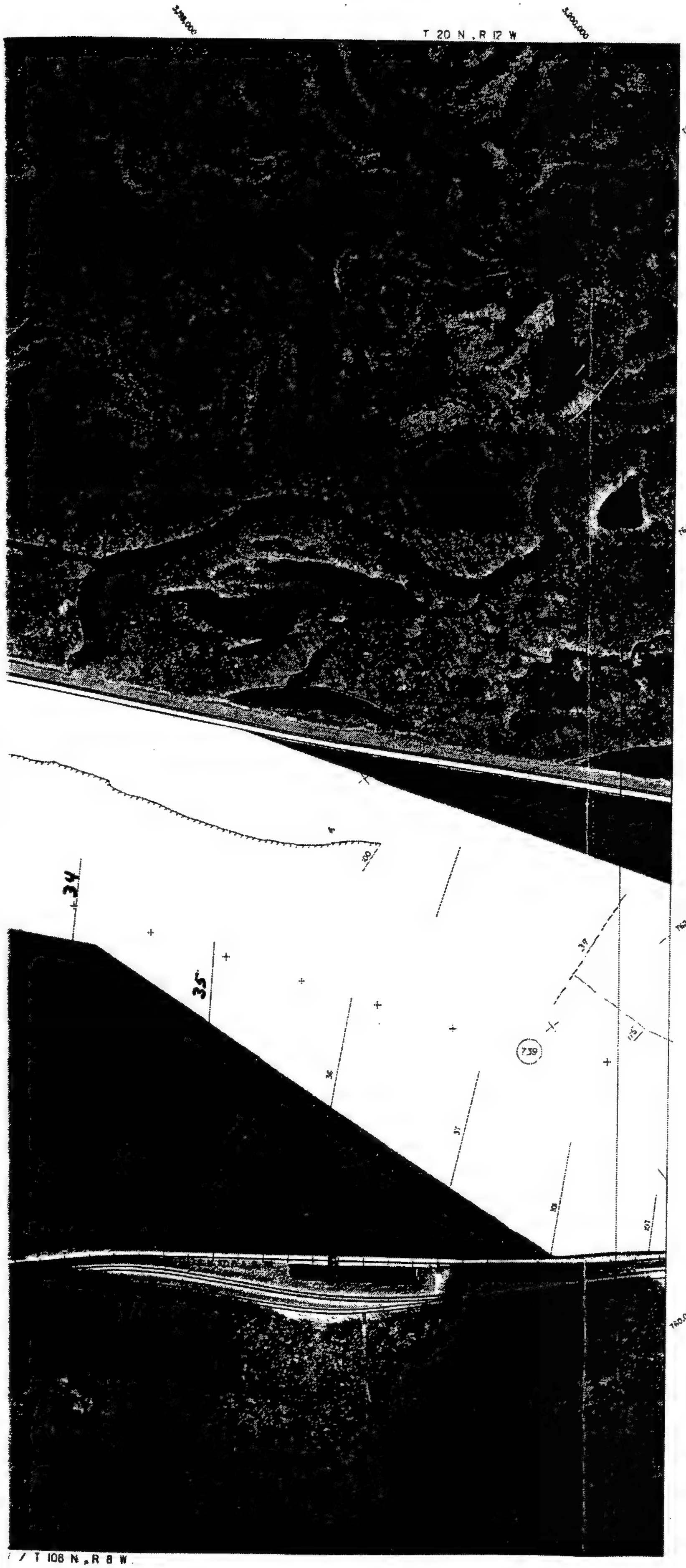
MILE 743.0 LCP 659.7
MILE 742.0 LCP 659.7
MILE 741.0 LCP 659.6

UPPER MISSISSIPPI RIVER IMPROVEMENT ST. PAUL DISTRICT		
MINNEISKA		
MILE 741.0 TO 743.3	SCALE 1"=400'	SHEET 5-03


T 108 N , R 9 W / T 109 N , R 9 W
26
30



T 20 N , R 12 W
740
739
30
33
34
35
T 108 N , R 9 W / T 108 N , R 8 W



HUB	AZIMUTH	DISTANCE	COORDINATES NORTH	COORDINATES EAST	ELEVATION

NOTE

CONTROL SURVEYS FURNISHED BY [illegible]

THIS MAP MEETS NATIONAL MAP ACCURACY STANDARDS

COORDINATES BASED ON MINNESOTA STATE PLANE GRID SYSTEM, SOUTH ZONE, N.A. DATUM OF [illegible]

DATE OF PHOTOGRAPHY: NOV., [illegible]

Surveyed By:________ Launch________ Acres ____

Gage Reading:______ Location:______ UMR

Individual	Initials	Date
Processor		
Unit Chief		
Channel Maintenance Coordinator		

____ 1. No Action
____ 2. Resurvey ________
____ 3. Dredge Area As Shown

Channel Maintenance Coordinator		
Chief, Waterways Section		
Project Manager		

Remarks ________

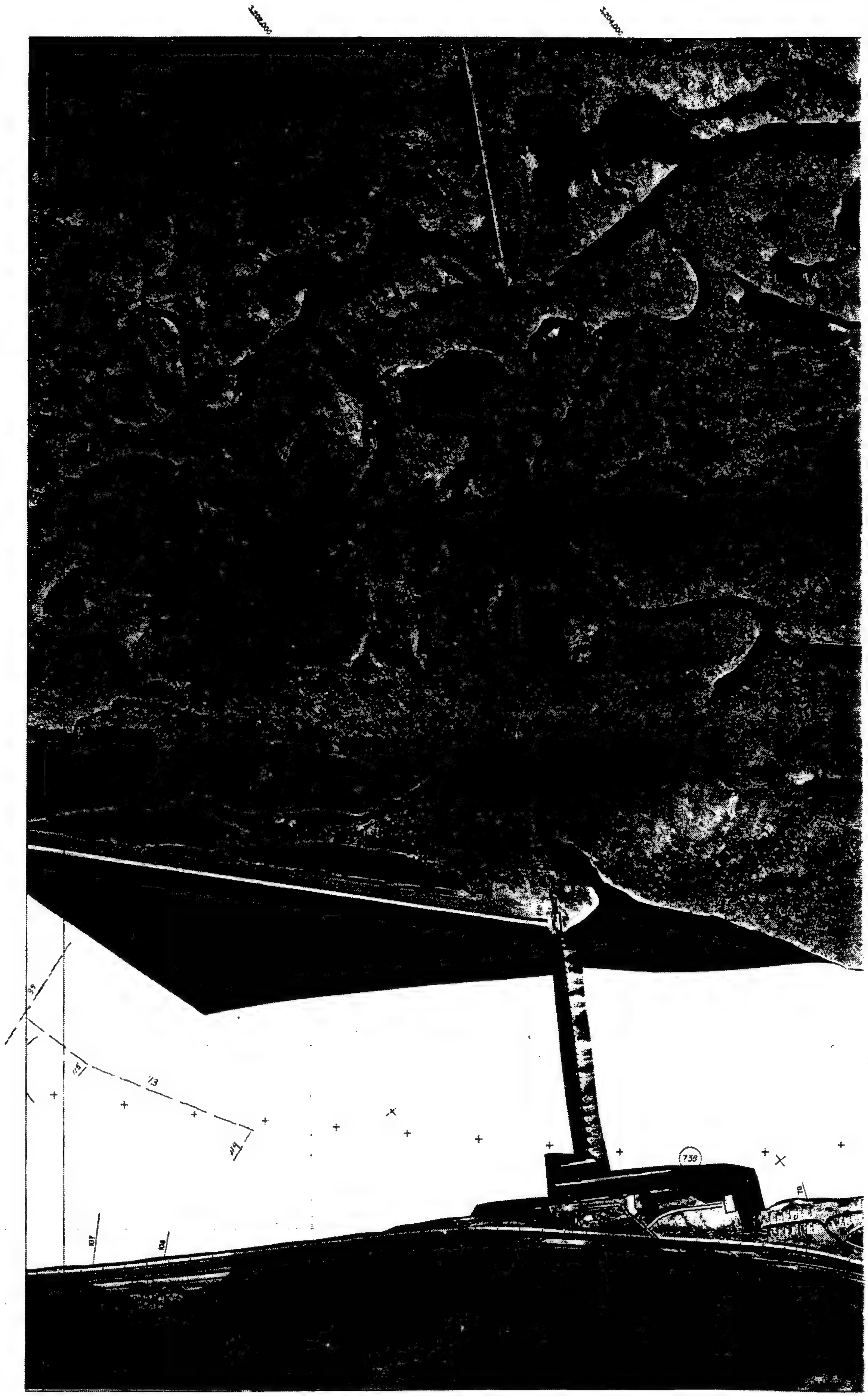
MILE 741.0 LCP 659.6
MILE 740.0 LCP 659.6
MILE 739.0 LCP 659.5

UPPER MISSISSIPPI RIVER IMPROVEMENT
ST. PAUL DISTRICT

MT. VERNON RICHMOND LT.

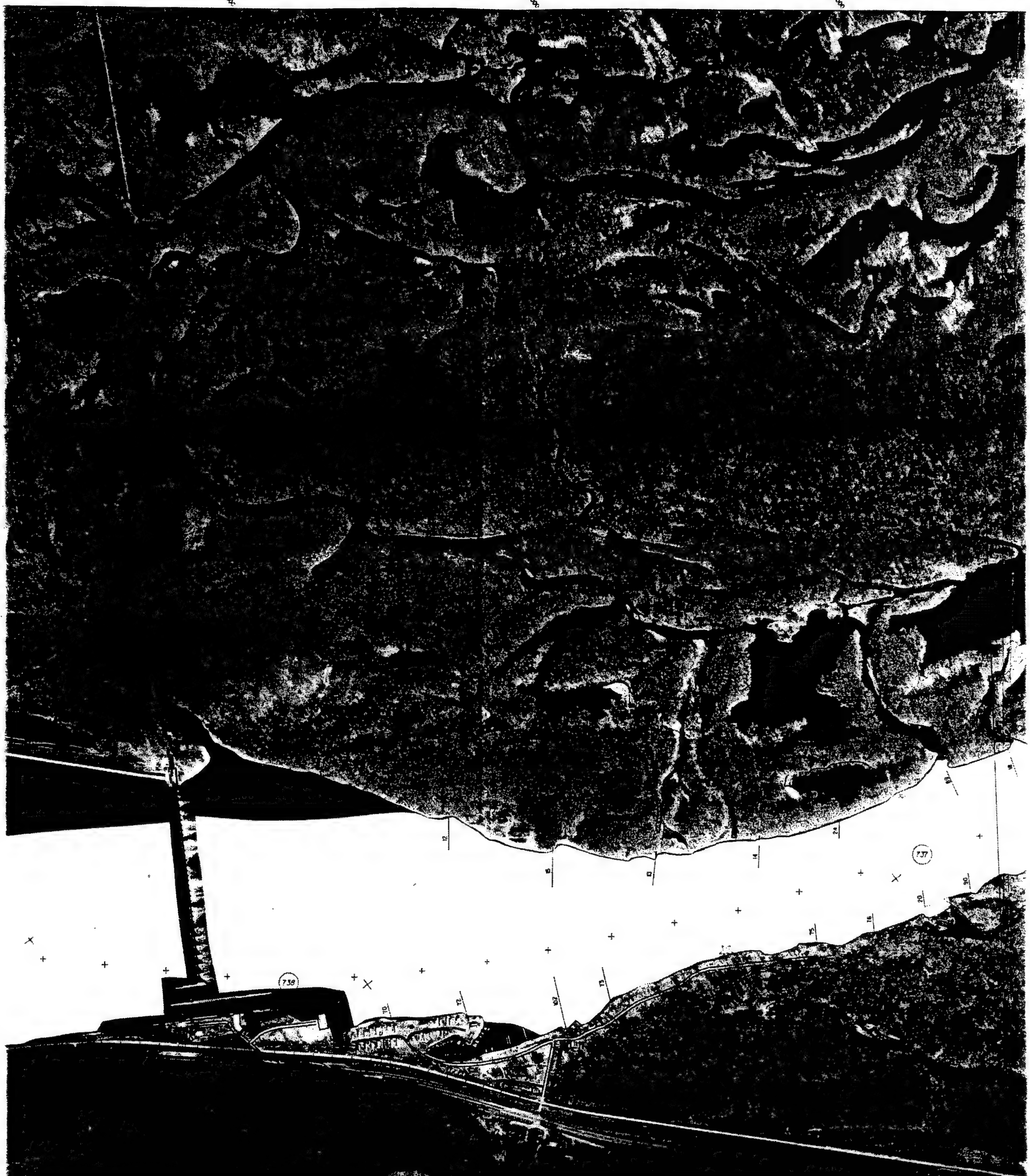
MILE 738.8 TO 741.0	SCALE 1"=400'	SHEET 5-02

Plate 5g



MARKHURD

1



T 108 N , R 8 W

HUB	AZIMUTH	DISTANCE	COORDINATES		ELEVATION
			NORTH	EAST	

NOTE

CONTROL SURVEYS FURNISHED BY ENVIROSCIENCE, INC.

THIS MAP MEETS NATIONAL MAP ACCURACY STANDARDS

COORDINATES BASED ON MINNESOTA STATE PLANE GRID SYSTEM, SOUTH ZONE, N.A. DATUM OF 1983.

DATE OF PHOTOGRAPHY: NOV., 1992

Surveyed By:_________ **Launch**___________ **Acres** ____

Gage Reading:_______ **Location:**_________ **UMR**

Individual	**Initials**	**Date**
Processor	____	____
Unit Chief	____	____
Channel Maintenance Coordinator	____	____

____ **1. No Action**
____ **2. Resurvey** ____________________
____ **3. Dredge Area As Shown**

Channel Maintenance Coordinator	____	____
Chief, Waterways Section	____	____
Project Manager	____	____

Remarks:______________________________

MILE 738.5 LCP 659.5
MILE 738.0 LCP 651.0
MILE 737.0 LCP 651.0

UPPER MISSISSIPPI RIVER IMPROVEMENT ST. PAUL DISTRICT		
L/D #5		
MILE 736.8 TO 739.0	SCALE 1"=400'	SHEET 5-01

Plate 5h

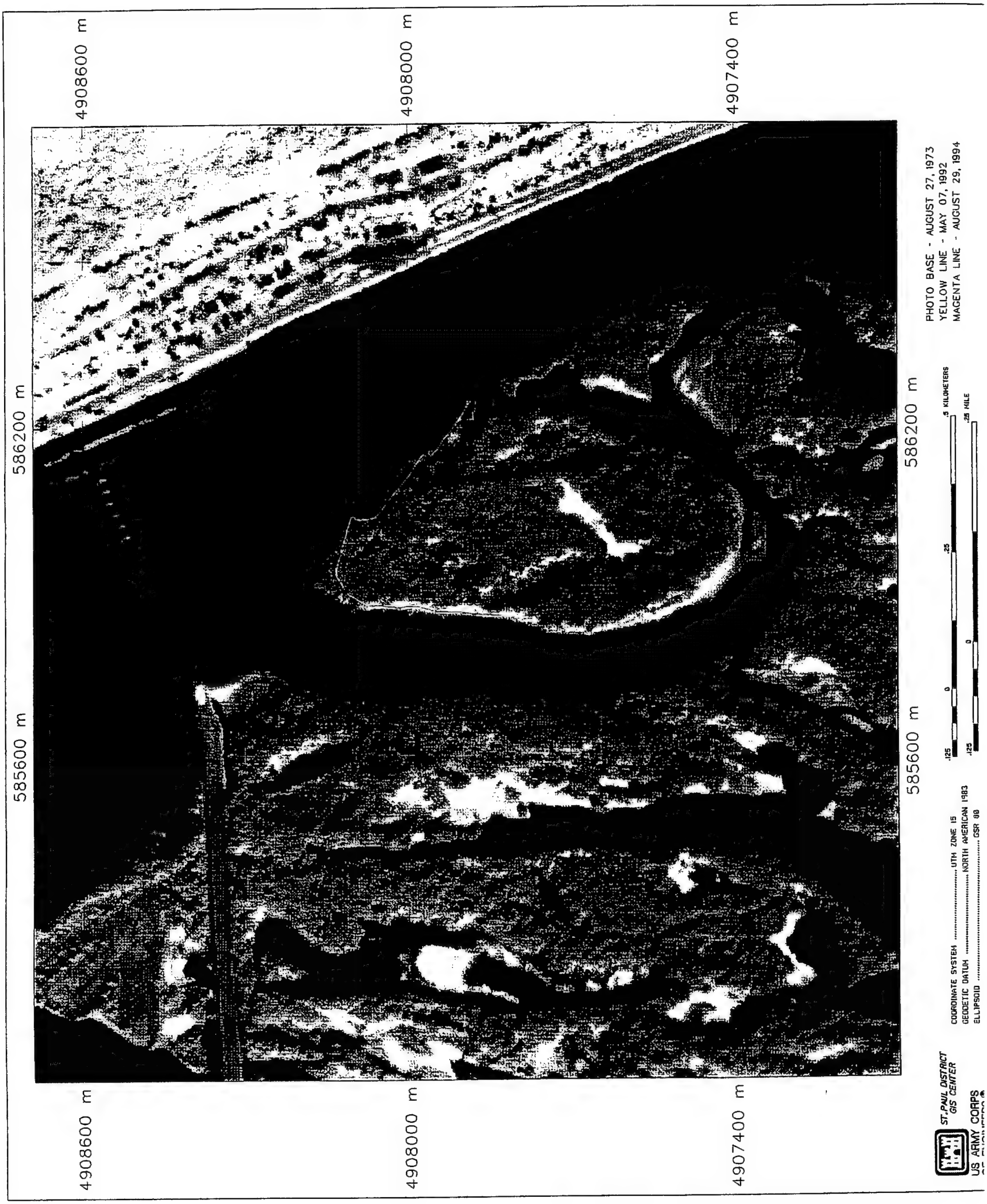


Plate 6. Head of Island 40 Land-Water Changes (1973-1994)

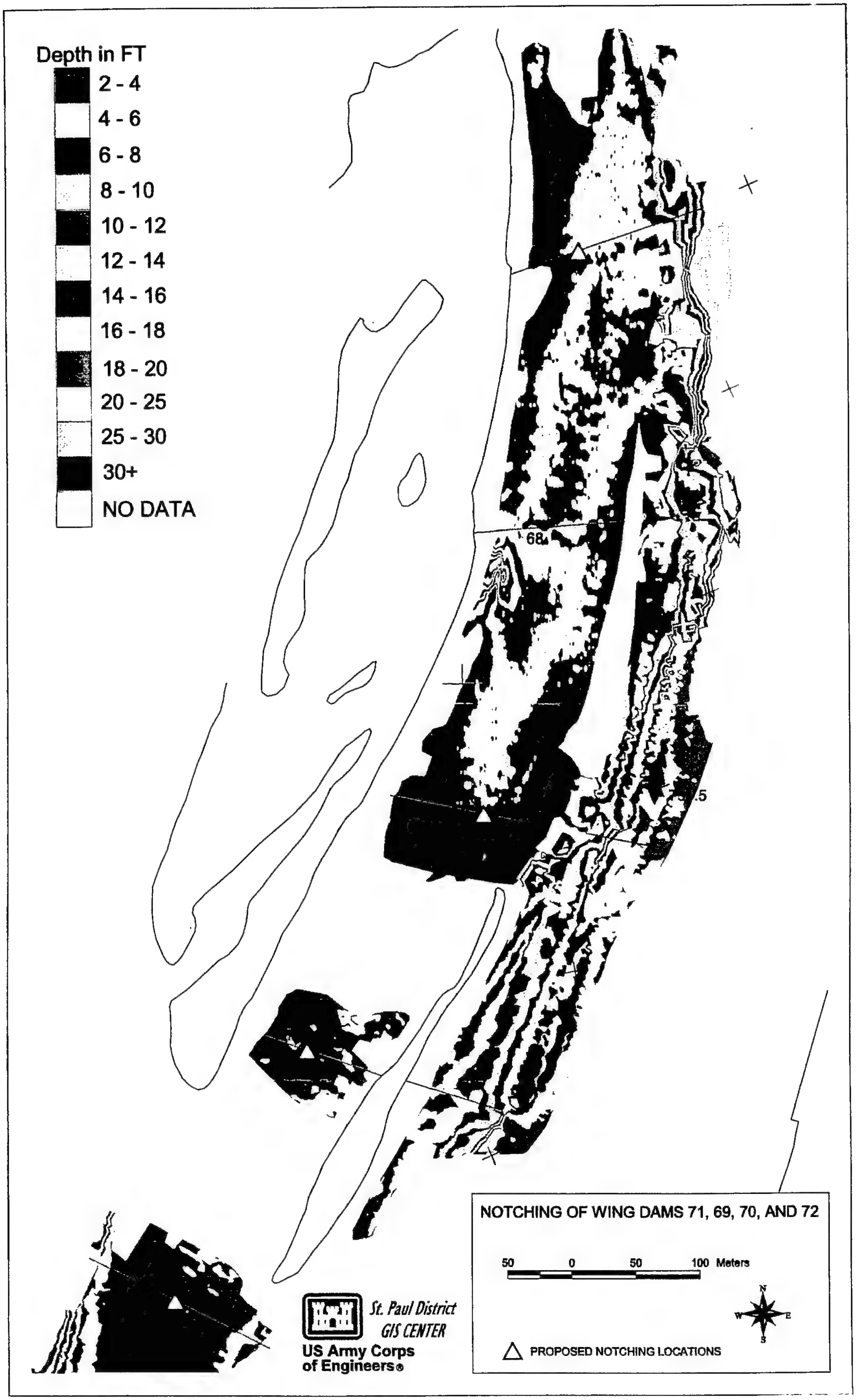
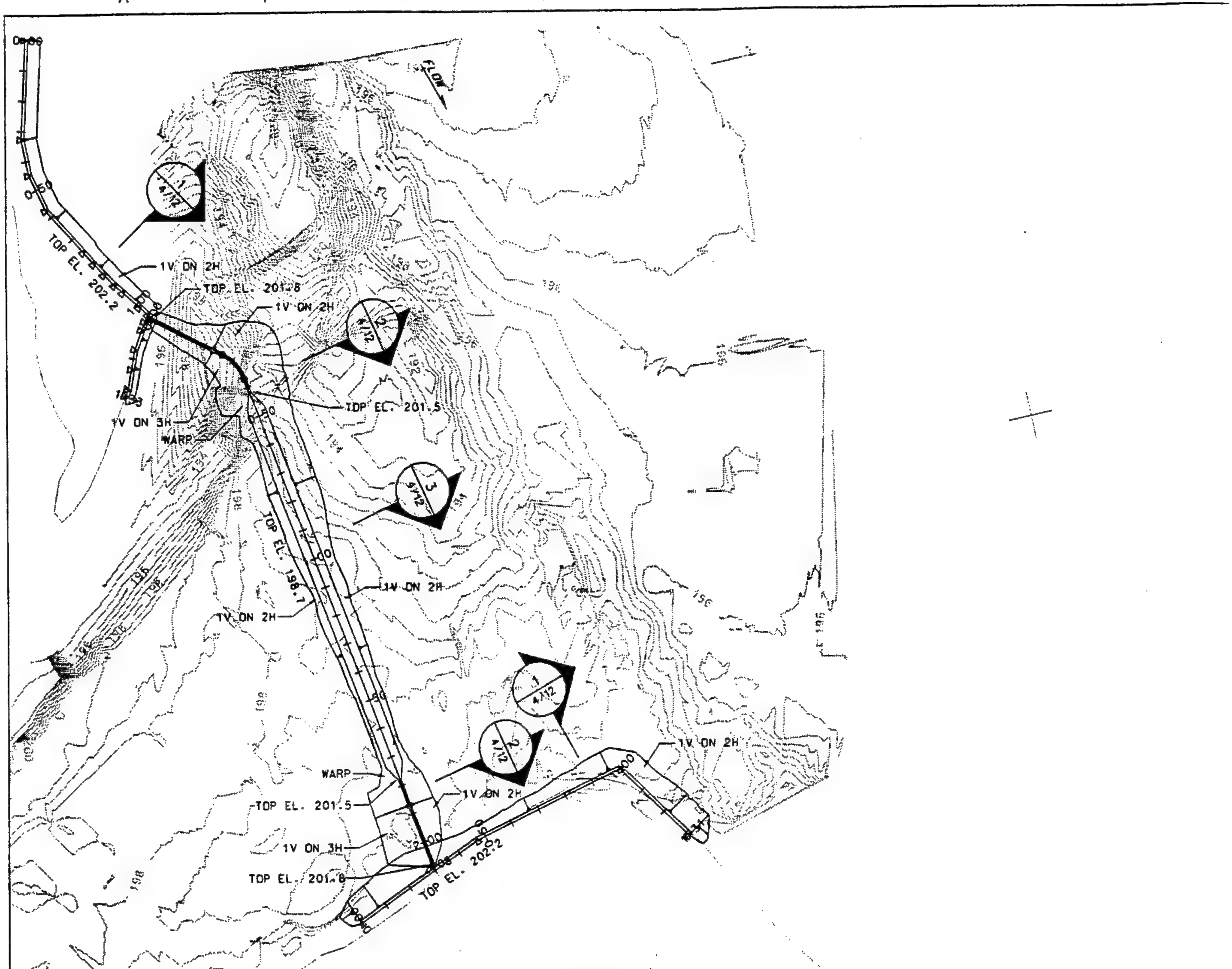
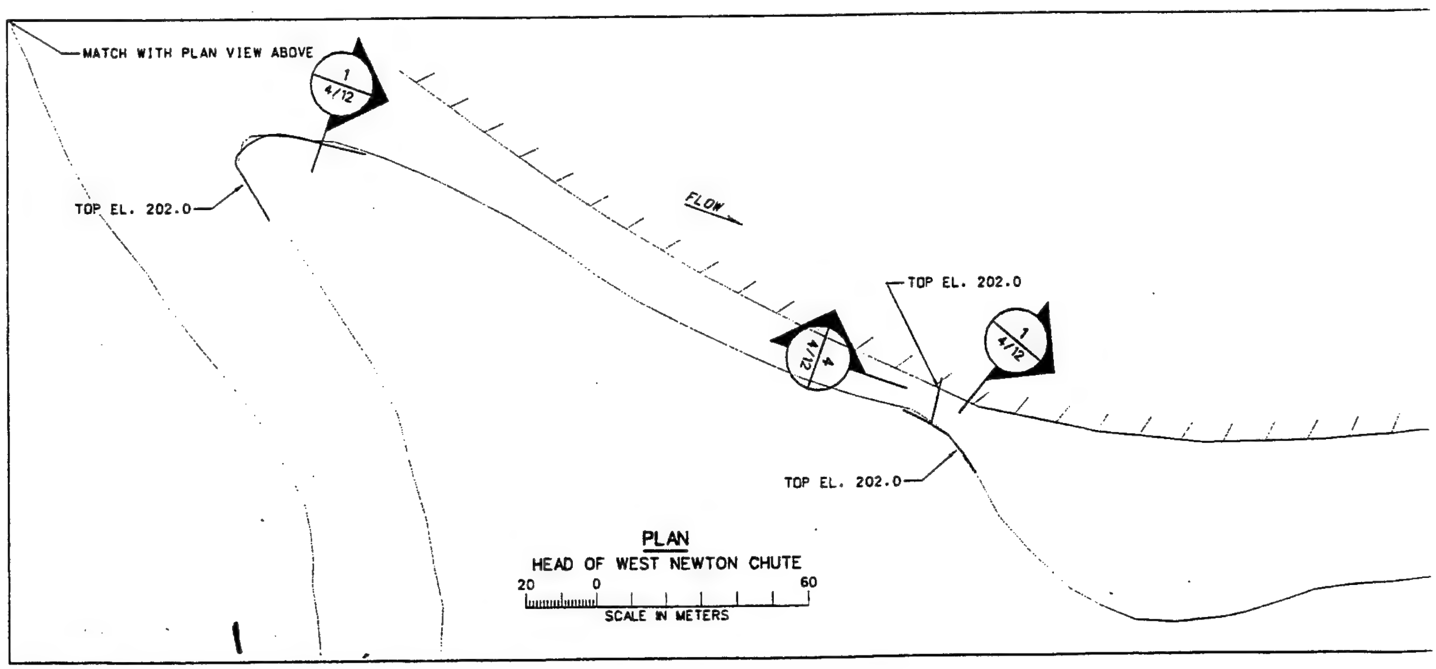

Depth in FT
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12
12 - 14
14 - 16
16 - 18
18 - 20
20 - 25
25 - 30
30+
NO DATA
68
5
NOTCHING OF WING DAMS 71, 69, 70, AND 72
50 0 50 100 Meters
N
W
E
S
PROPOSED NOTCHING LOCATIONS
St. Paul District
GIS CENTER
US Army Corps
of Engineers

Plate 8. Head of West Newton Chute Land-Water Changes (1964-1994)

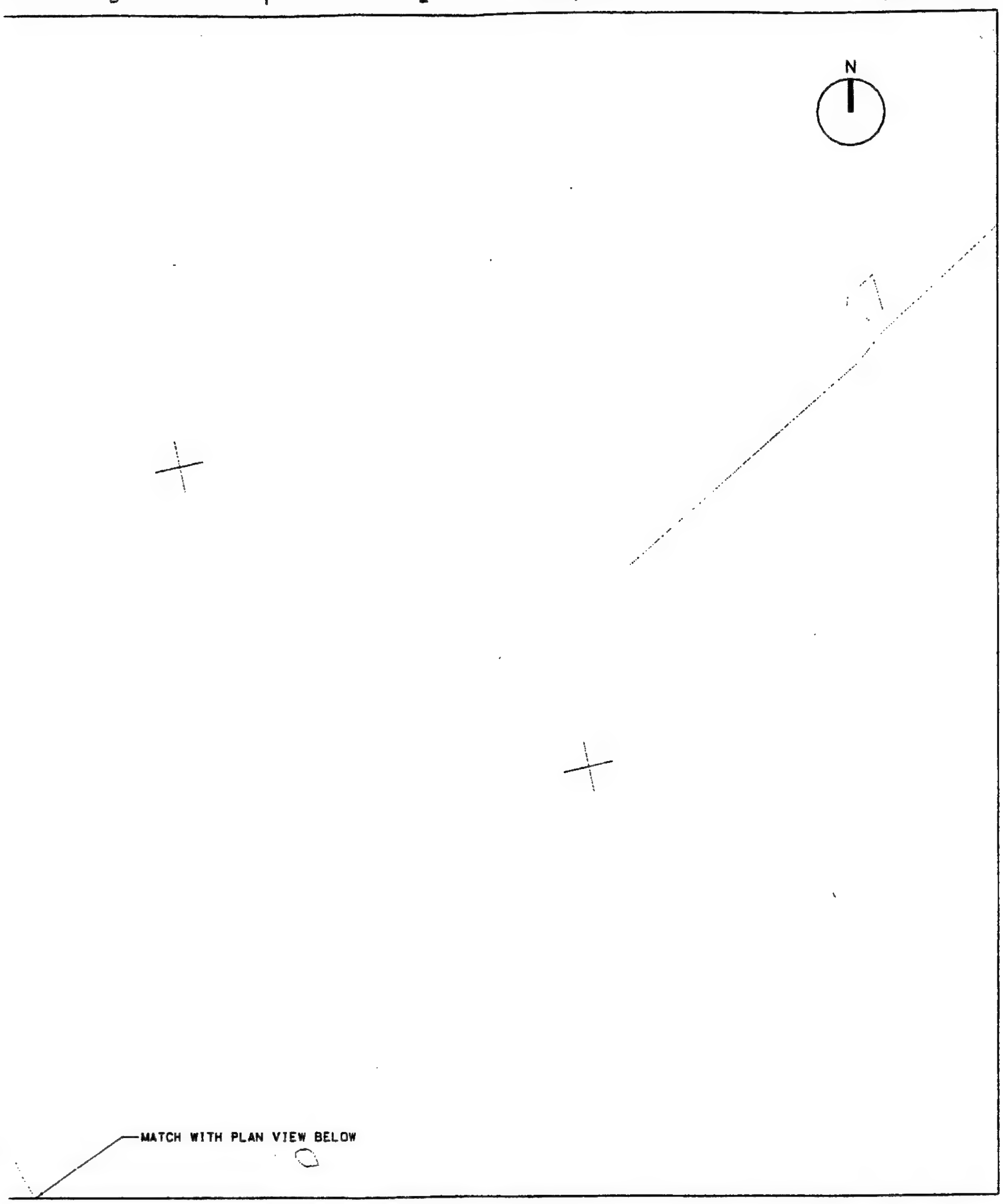


PLAN
HEAD OF WEST NEWTON CHUTE
20 0 60
SCALE IN METERS



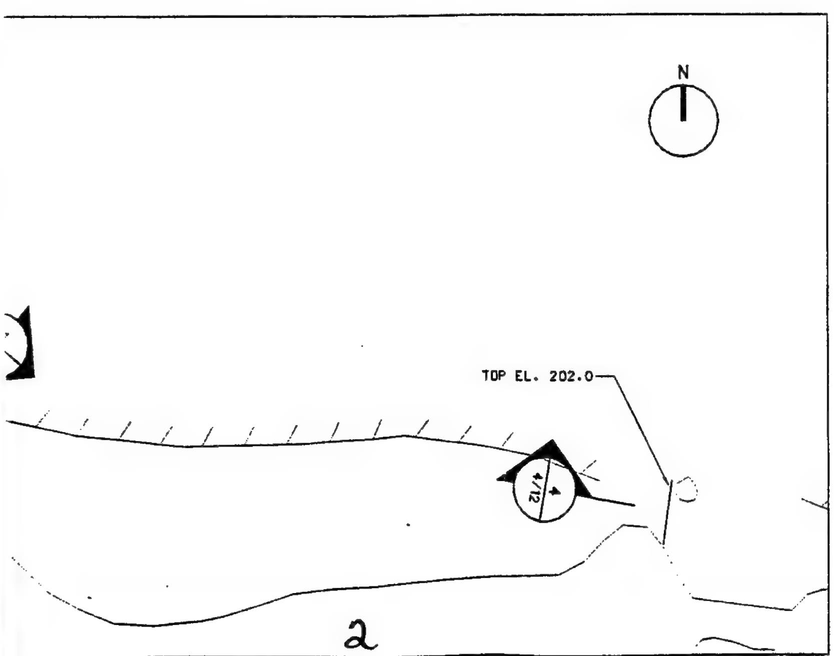
PLAN
HEAD OF WEST NEWTON CHUTE
20 0 60
SCALE IN METERS

D E F G H

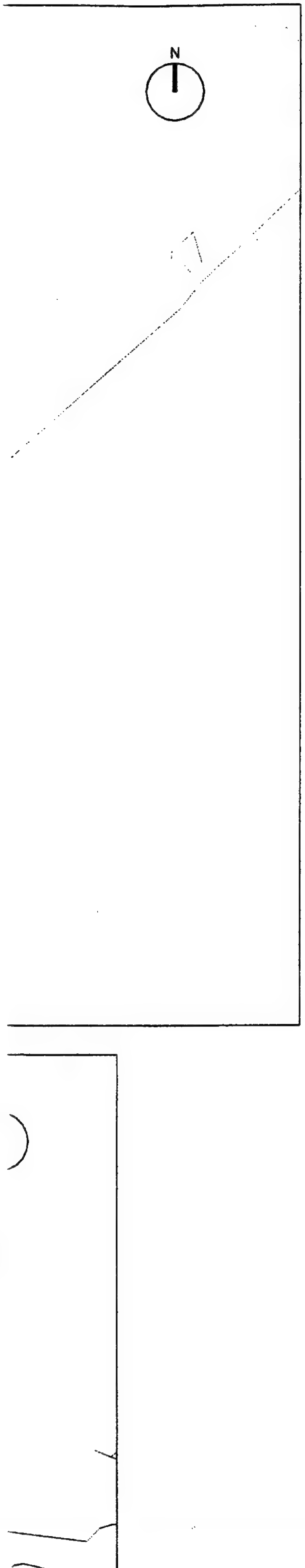


NOTES:

1. UNLESS OTHERWISE NOTED, UNITS SHOWN ARE IN METERS.
2. CONTOUR INTERVAL IS 0.5M.



D E F G H



NOTES:

1. UNLESS OTHERWISE NOTED, UNITS SHOWN ARE IN METERS.
2. CONTOUR INTERVAL IS 0.5M.

US Army Corps of Engineers
St. Paul District

Symbol	Description	Date	Appr.

DESIGNED: JGS/JJF	SCALE: AS SHOWN	DATE: SEPT 1998
CHECKED: XXX/XXX	CADD FILE NAME: CR1M5001.DGN	
DRAWN: JGS	SOL NO: DACW37-99-B-0000	
DESIGNED: SMG	AE APPROVING OFFICIAL:	
CHECKED: XXX/XXX		

PE-D

PE-H

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

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RESERVED FOR AE ADDRESS
ANYTOWN, USA

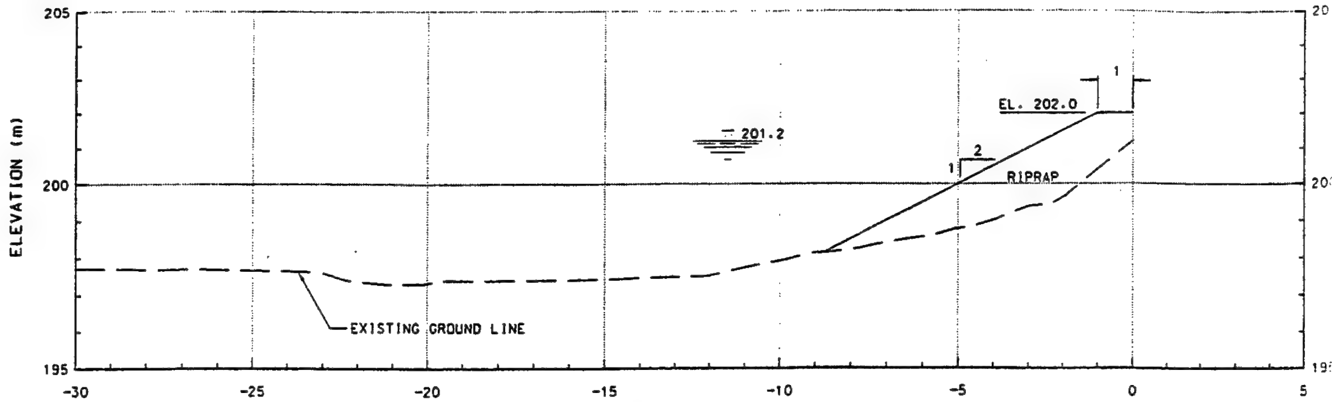
POOL 5 CHANNEL MANAGEMENT STUDY
SITE WORK
PLAN
HEAD OF WEST NEWTON CHUTE

DRAWING NUMBER:
BASIN-T-CC/FNO.01

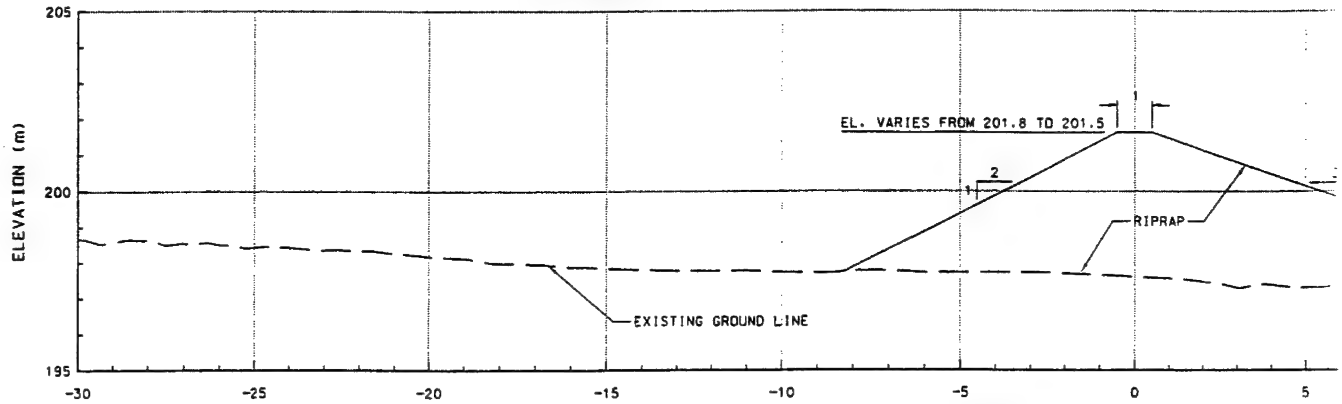
SHT 3 OF 12

Plate 9

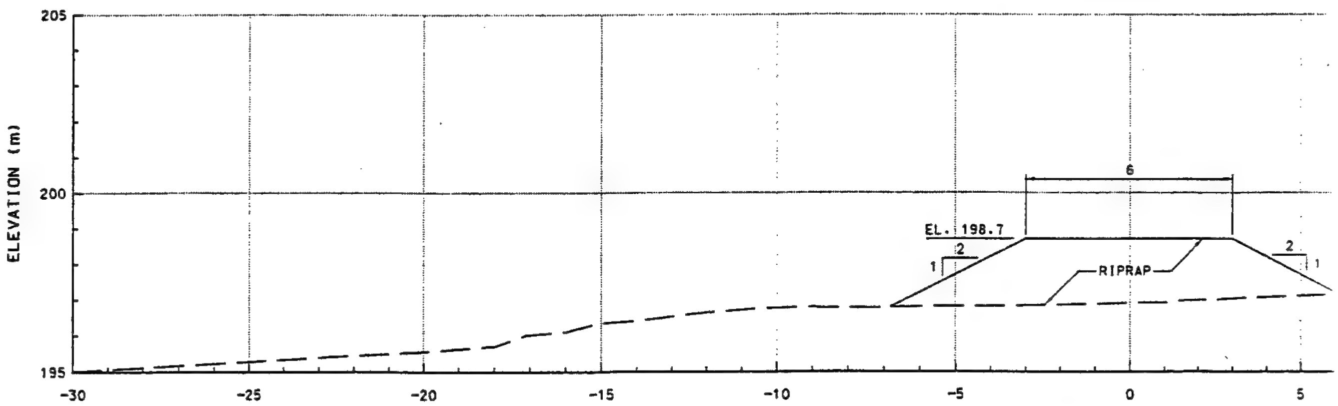
3



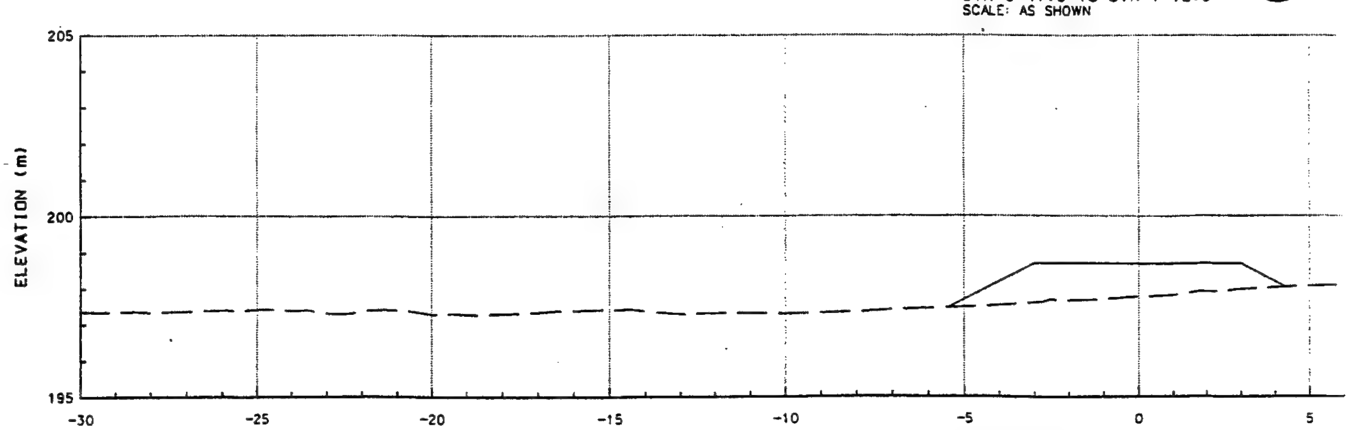
SECTION
BANK PROTECTION
SCALE: AS SHOWN
1
3/12



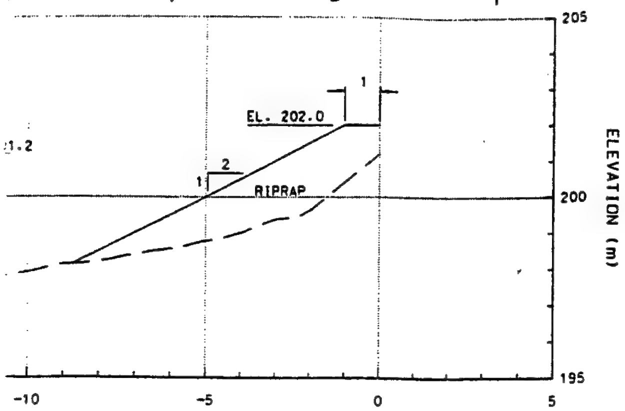
SECTION
CLOSING DAM
STA 0+00 TO STA 0+42
STA 1+78 TO STA 2+08.41
SCALE: AS SHOWN
2
3/12



SECTION
CLOSING DAM
STA 0+47.5 TO STA 1+72.5
SCALE: AS SHOWN
3
3/12



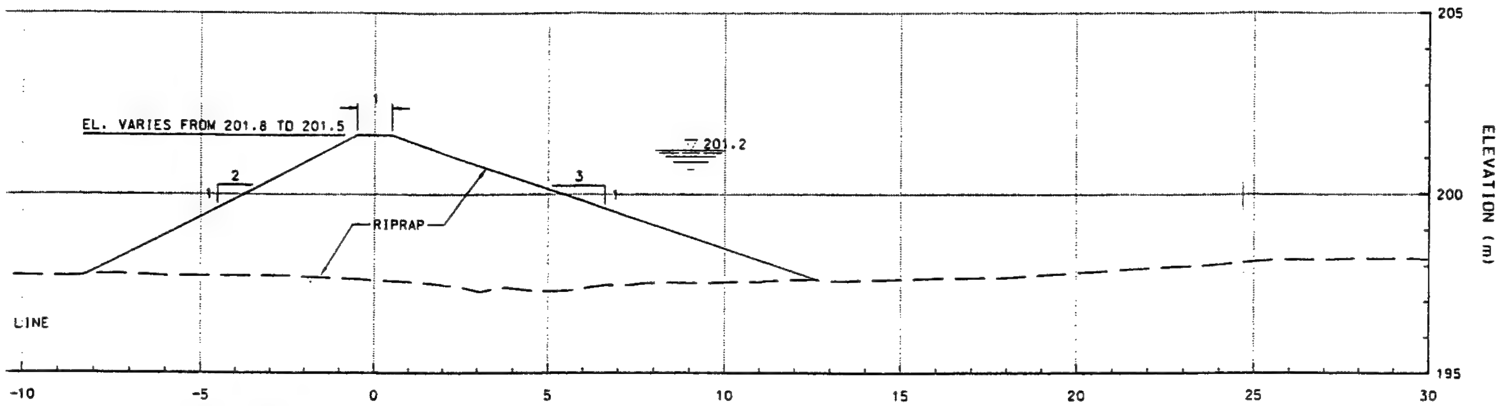
SECTION
DAY MARK TIE-IN
SCALE:
4
3/12



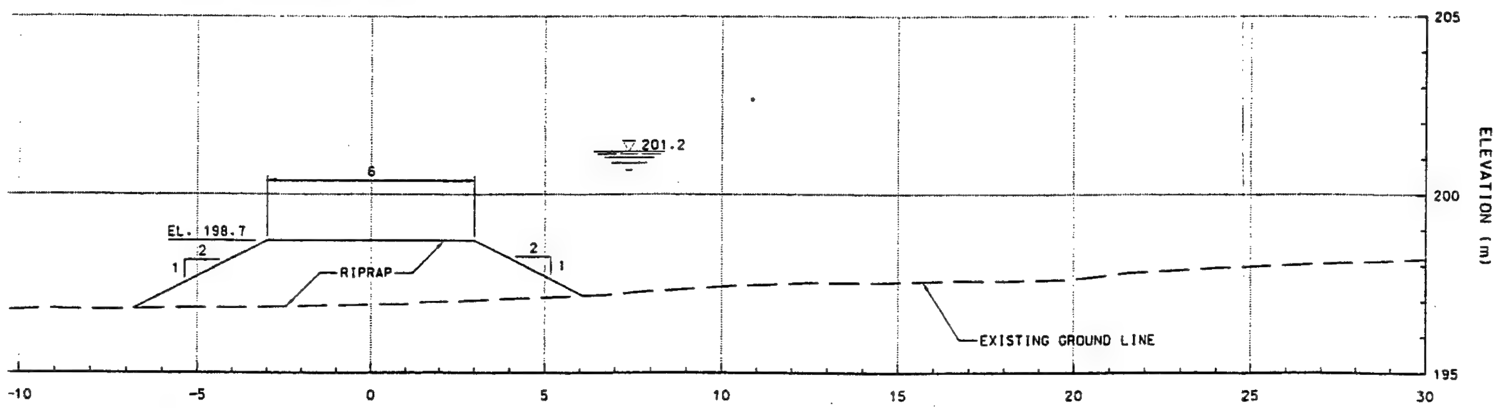
1
3/12

NOTES:

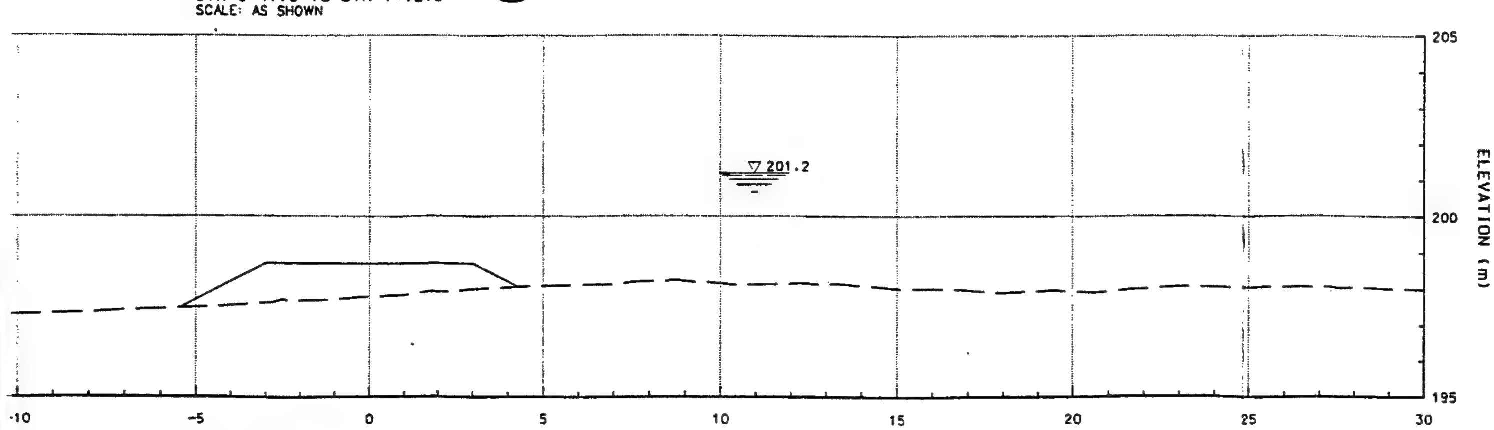
1. UNLESS OTHERWISE NOTED, UNIT



SECTION 2 3/12
CLOSING DAM
STA 0+00 TO STA 0+42
STA 1+78 TO STA 2+08.41
SCALE: AS SHOWN



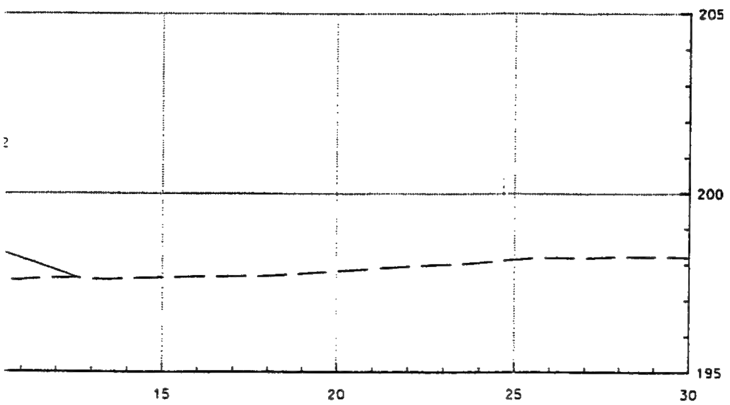
SECTION 3 3/12
CLOSING DAM
STA 0+47.5 TO STA 1+72.5
SCALE: AS SHOWN

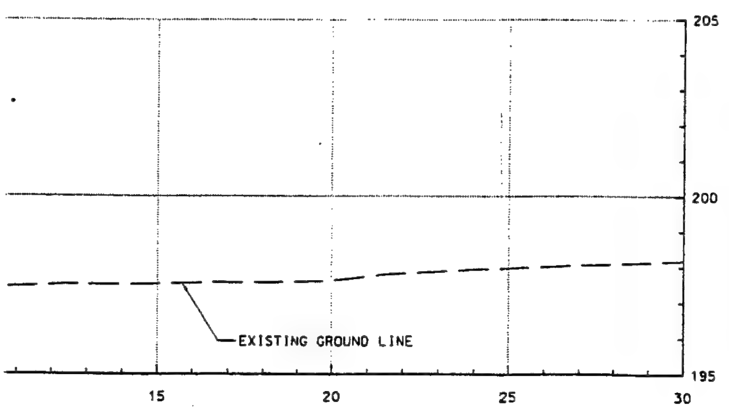


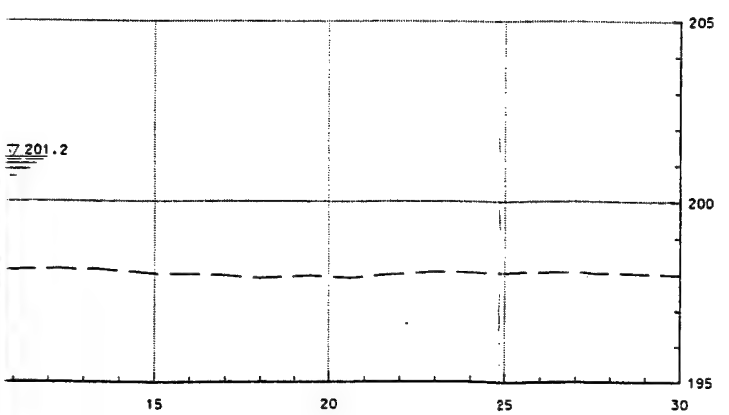
SECTION 4 3/12
DAY MARK TIE-IN
SCALE:

NOTES:

1. UNLESS OTHERWISE NOTED. UNITS SHOWN ARE IN METERS.







US Army Corps of Engineers
St. Paul District

Symbol	Description	Date	Appr.

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CHECKED: XXX/XXX
DRAWN: JGS
PE-D
DESIGNED: SMG
CHECKED: XXX/XXX
PE-H
SCALE: AS SHOWN
DATE: SEPT 1998
CADD FILE NAME: CR3M5001.DGN
SOL NO: DACW37-99-B-0000
AE APPROVING OFFICIAL:

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

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RESERVED FOR AE ADDRESS
ANYTOWN, USA

POOL 5 CHANNEL MANAGEMENT STUDY
SITE WORK
TYPICAL SECTIONS
HEAD OF WEST NEWTON CHUTE

DRAWING NUMBER:
BASIN-T-CC/FNO.01
SHT 4 OF 12

Plate 10

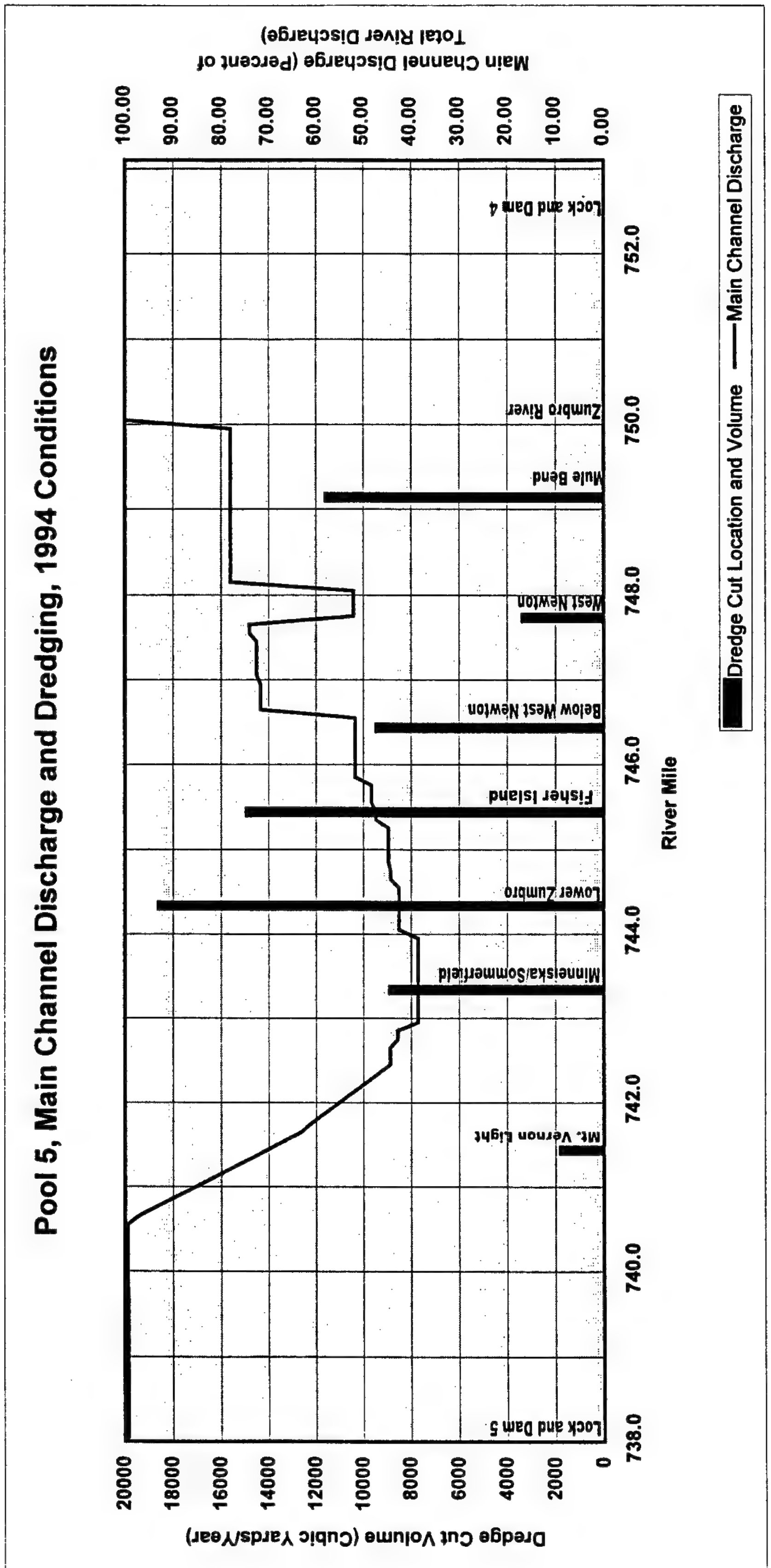
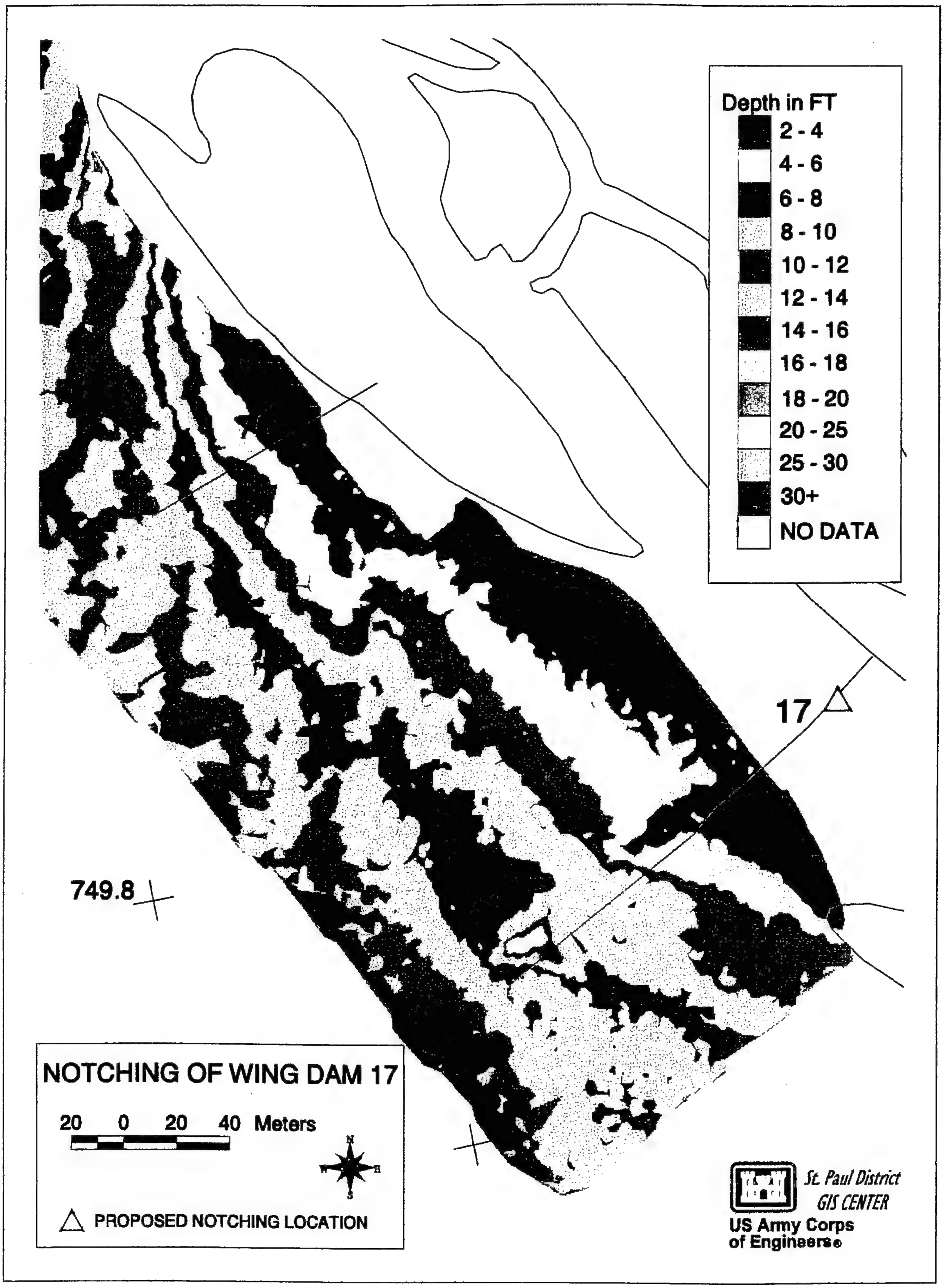
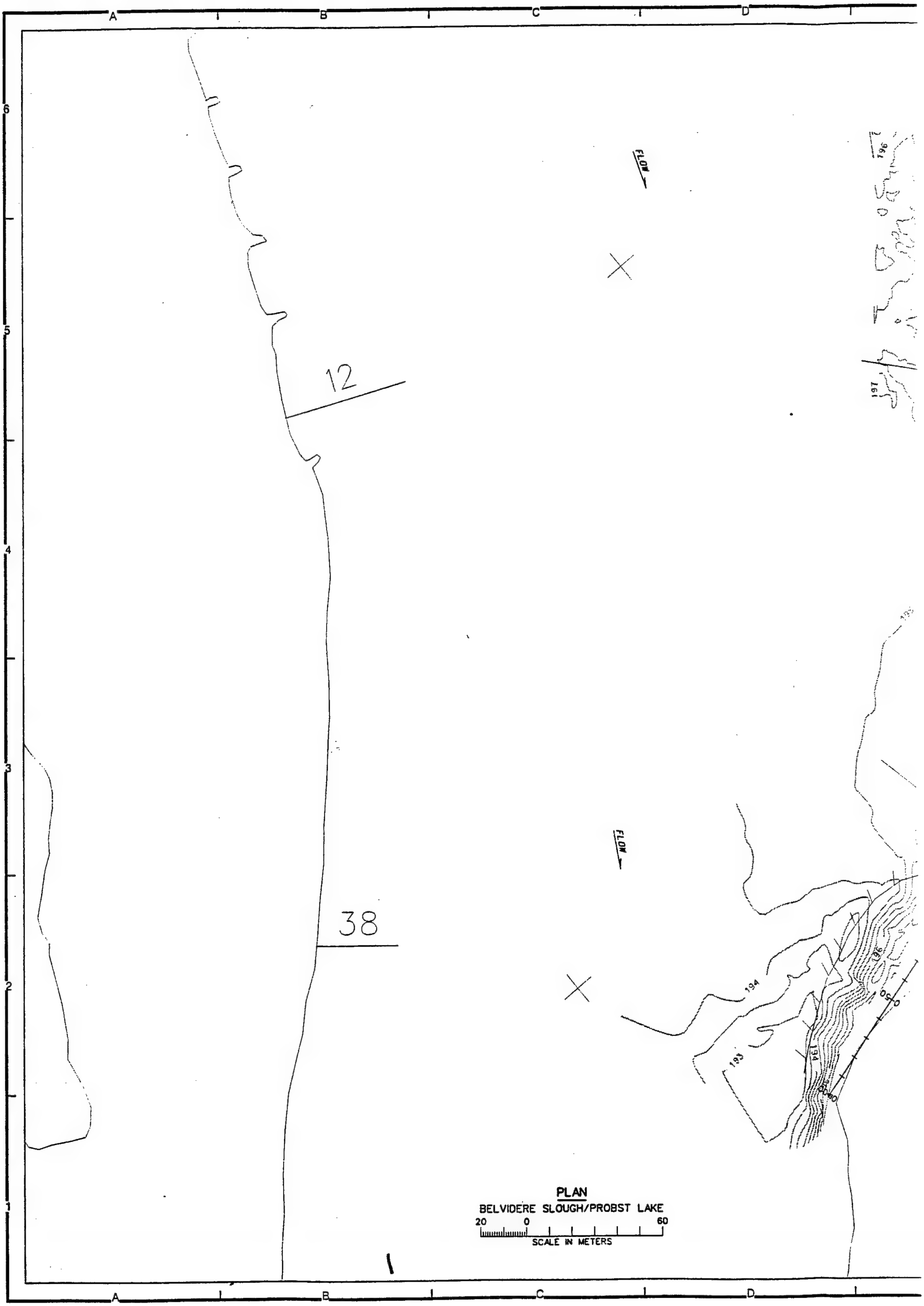


Plate 11. Pool 5 - Channel Discharges and Dredging Requirements



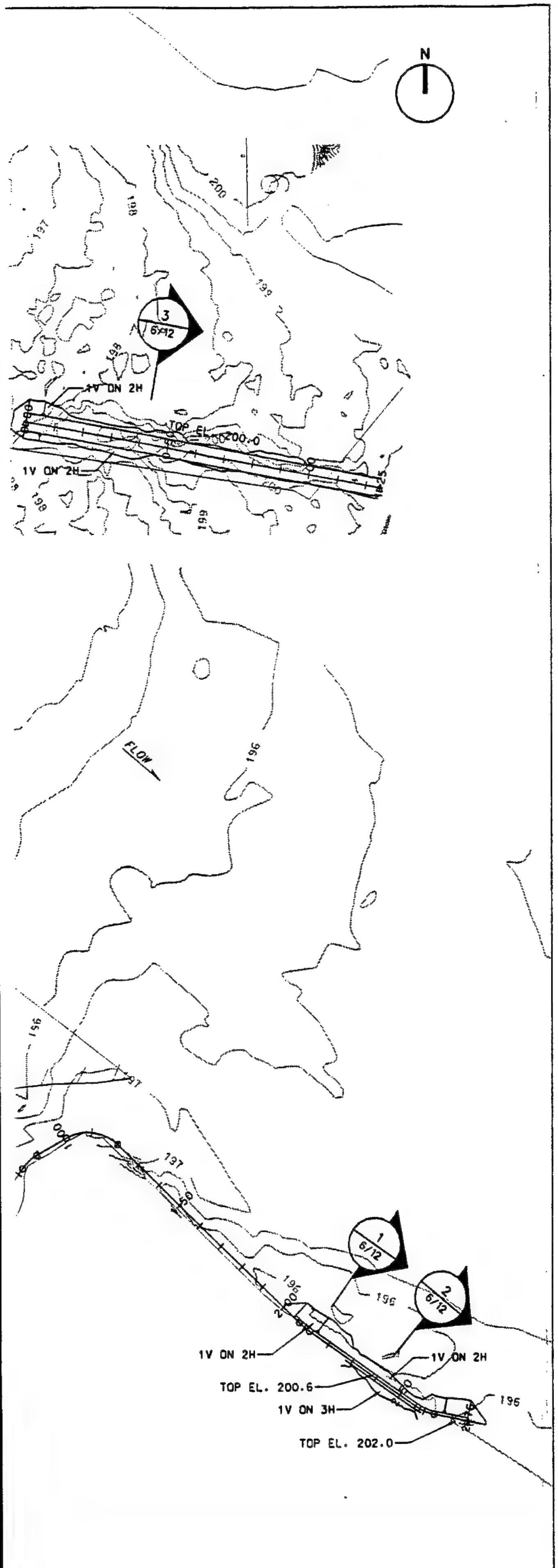
Depth in FT
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12
12 - 14
14 - 16
16 - 18
18 - 20
20 - 25
25 - 30
30+
NO DATA
17
749.8
NOTCHING OF WING DAM 17
20 0 20 40 Meters
N
S
PROPOSED NOTCHING LOCATION
St. Paul District
GIS CENTER
US Army Corps
of Engineers®



A
B
C
D
6
5
4
3
2
1
FLOW
FLOW
12
38
196
197
194
193
196
194
PLAN
BELVIDERE SLOUGH/PROBST LAKE
20
0
60
SCALE IN METERS

PLAN
BELVIDERE SLOUGH/PROBST LAKE
20 0 60
SCALE IN METERS

NOTES:
1. UNLESS OTHERW
2. CONTOUR INTER



NOTES:

1. UNLESS OTHERWISE NOTED, UNITS SHOWN ARE IN METERS.
2. CONTOUR INTERVAL IS 0.5M.

US Army Corps of Engineers
St. Paul District

Symbol	Description	Date	Appr.

DESIGNED: JGS/JJF	SCALE: AS SHOWN	DATE: OCT 1998
CHECKED: XXX/XXX	CADD FILE NAME: CR1M5002.DGN	
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DESIGNED: SMG	AE APPROVING OFFICIAL:	
CHECKED: XXX/XXX		

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

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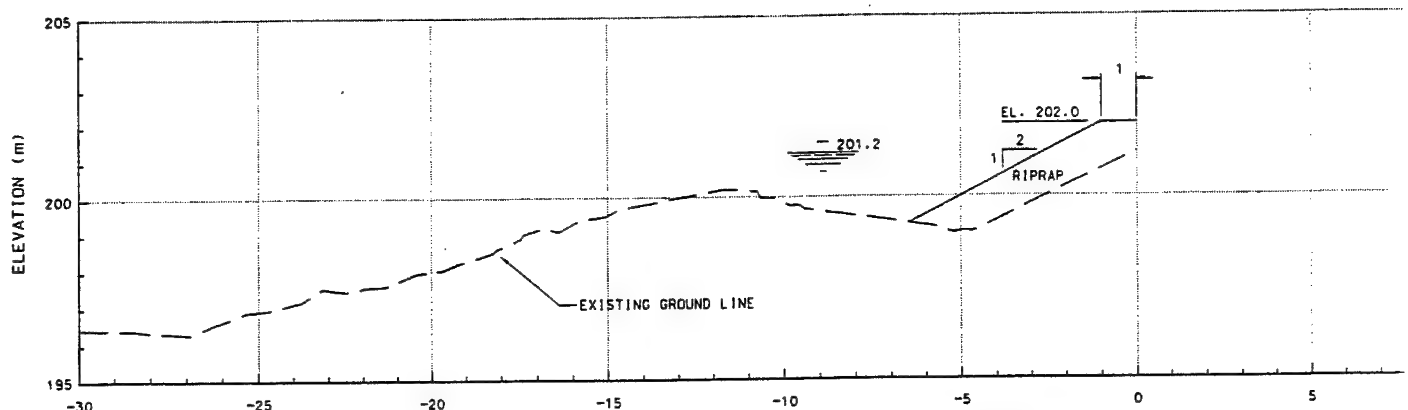
ANYTOWN, USA

POOL 5 CHANNEL MANAGEMENT STUDY
SITE WORK
PLAN
BELVIDERE SLOUGH/PROBST LAKE

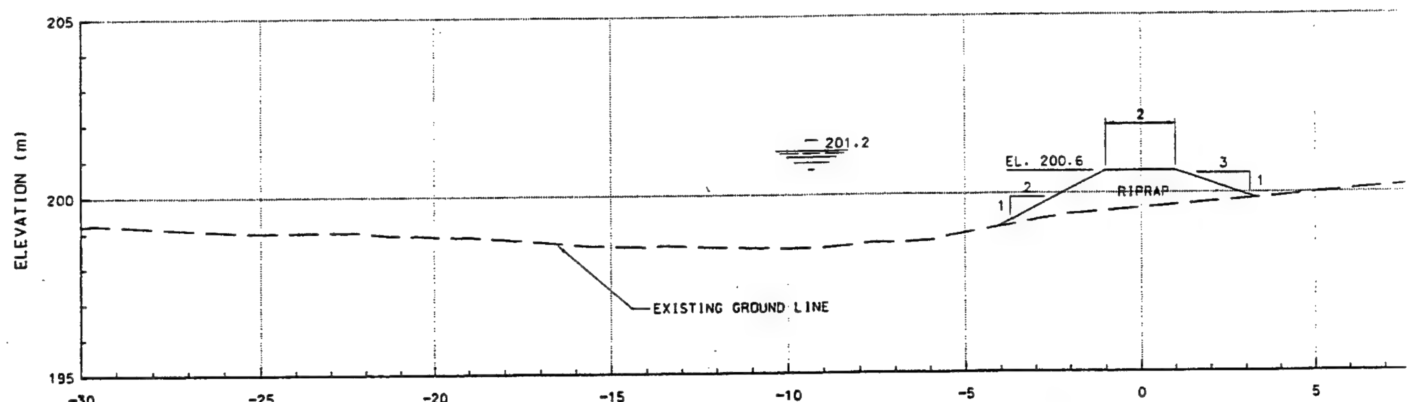
DRAWING NUMBER:
BASIN-T-CC/FNO.01

SHT 5 OF 12

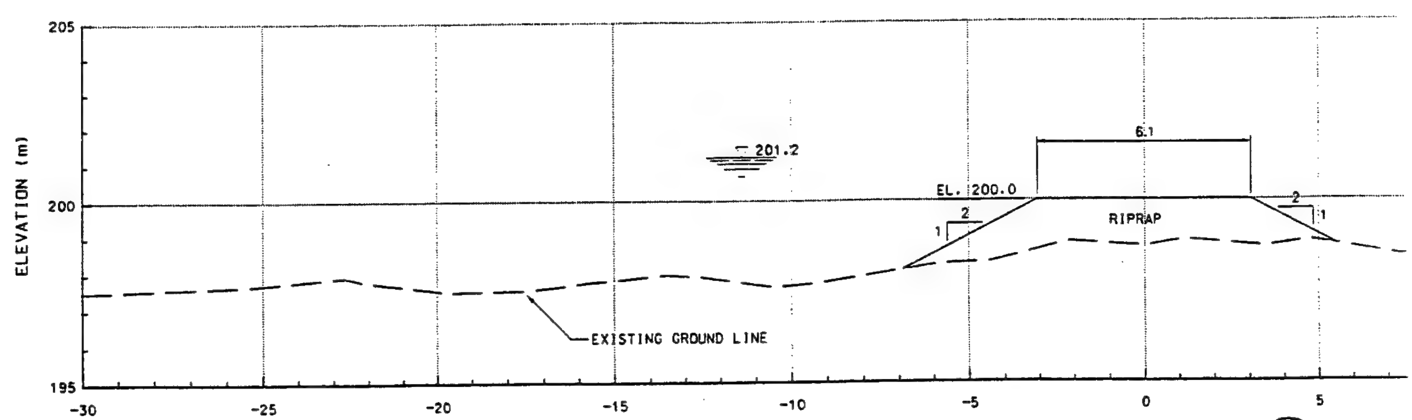
Plate 13



SECTION
BANK PROTECTION
SCALE: AS SHOWN
1
5/12



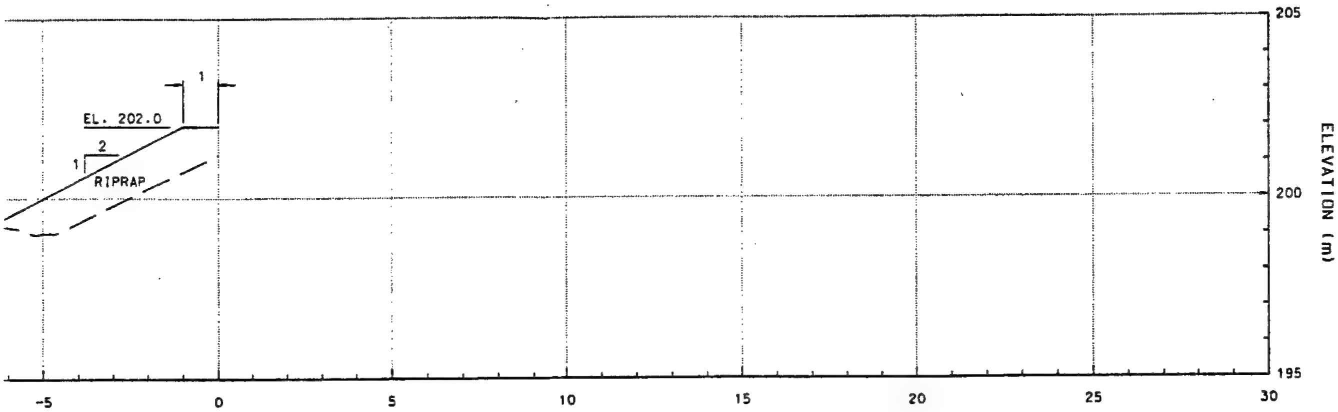
SECTION
CHANNEL LINER
SCALE: AS SHOWN
2
5/12



SECTION
WINGDAM 9 REHAB
SCALE: AS SHOWN
3
5/12

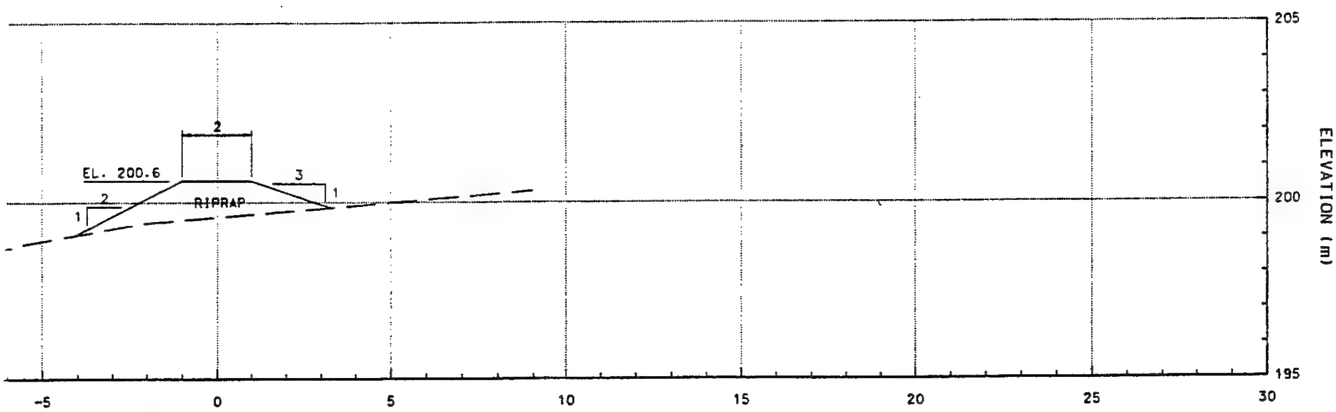
NOTES:

1. UNLESS OTHERWISE NOTED, UNITS SHOWN ARE IN METE



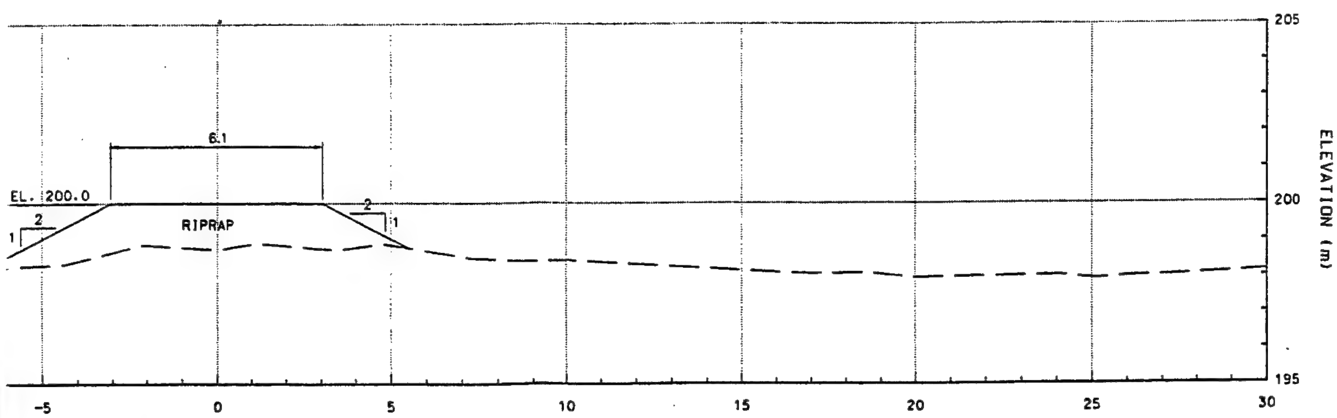
SECTION
BANK PROTECTION
SCALE: AS SHOWN

1
5/12



SECTION
CHANNEL LINER
SCALE: AS SHOWN

2
5/12



SECTION
WINGDAM 9 REHAB
SCALE: AS SHOWN

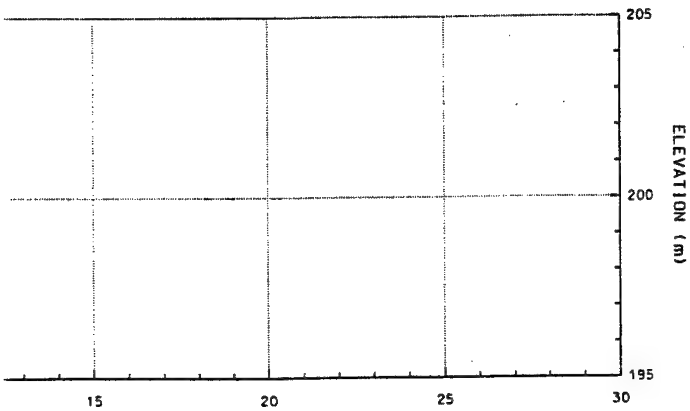
3
5/12

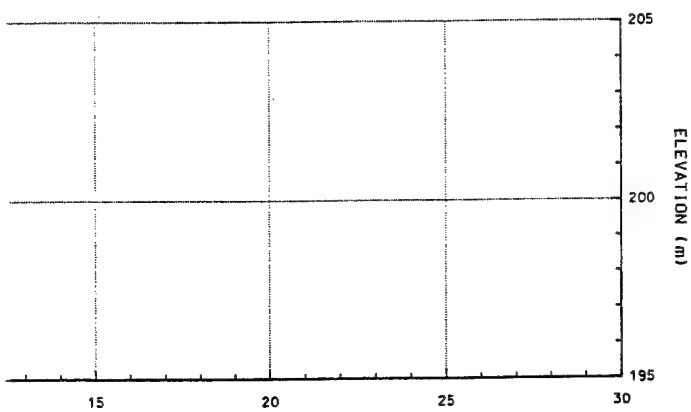
Plate

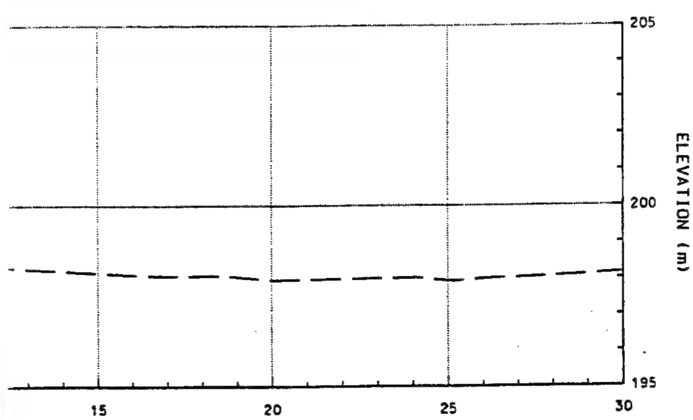
2

NOTES:

1. UNLESS OTHERWISE NOTED, UNITS SHOWN ARE IN METERS.







US Army Corps of Engineers
St. Paul District

Symbol	Description	Date	Appr.

PE-D	DESIGNED: JGS/JJF CHECKED: XXX/XXX DRAWN: JGS	SCALE: AS SHOWN · DATE: SEPT 1998 CADD FILE NAME: CR3M5002.DGN SOL NO: DACW37-99-B-0000
PE-H	DESIGNED: SMG CHECKED: XXX/XXX	AE APPROVING OFFICIAL:

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

RESERVED FOR AE LOGO
RESERVED FOR AE ADDRESS
ANYTOWN, USA

POOL 5 CHANNEL MANAGEMENT STUDY

SITE WORK

TYPICAL SECTIONS
BELVIDERE SLOUGH/PROBST LAKE

DRAWING NUMBER:
BASIN-T-CC/FNO.01

SHT 6 OF 12

Plate 14

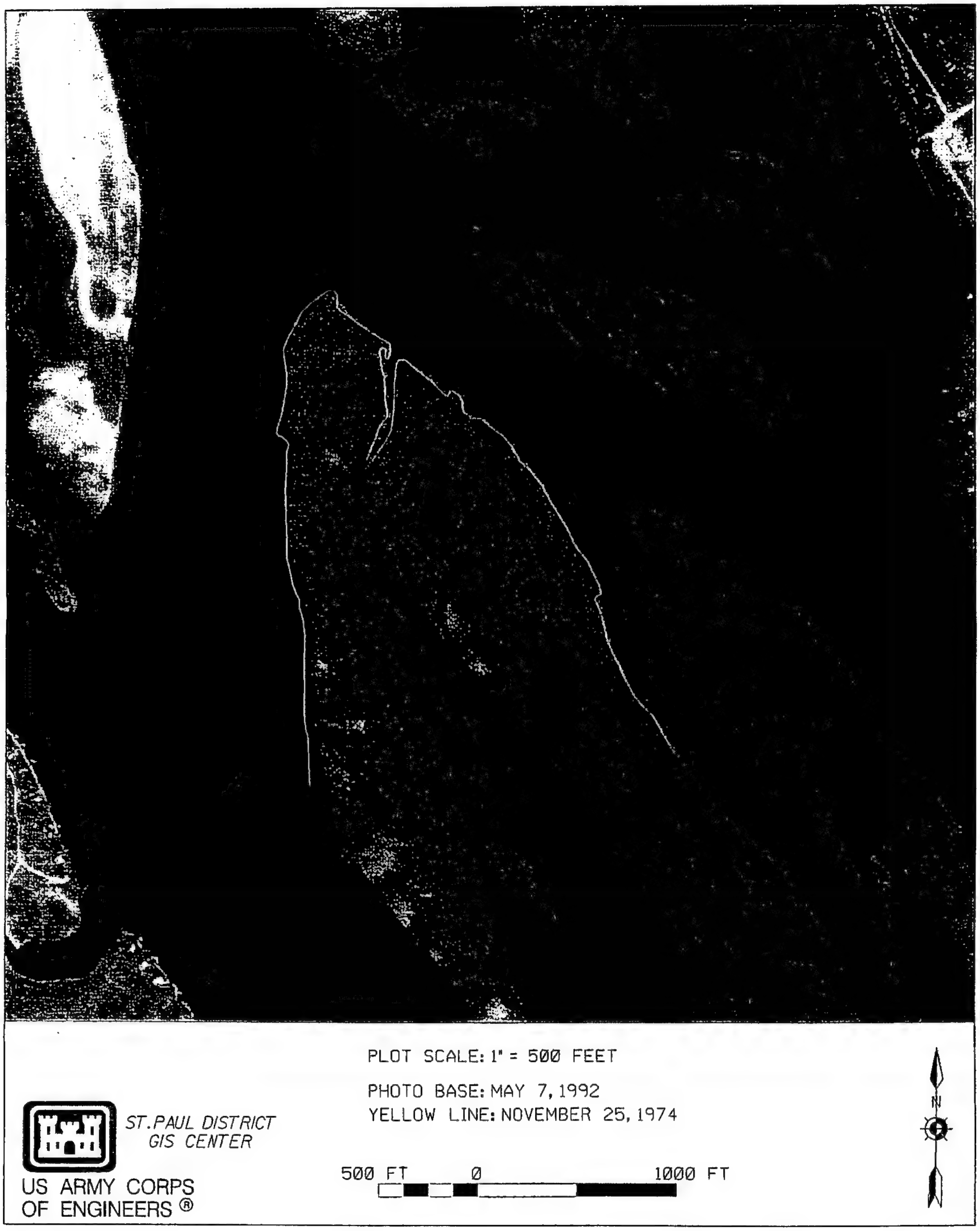


Plate 15. Head of Belvidere Slough Land-Water Changes (1974-1992)

Sand Plugs Near Murphy's Cut - Pool 5

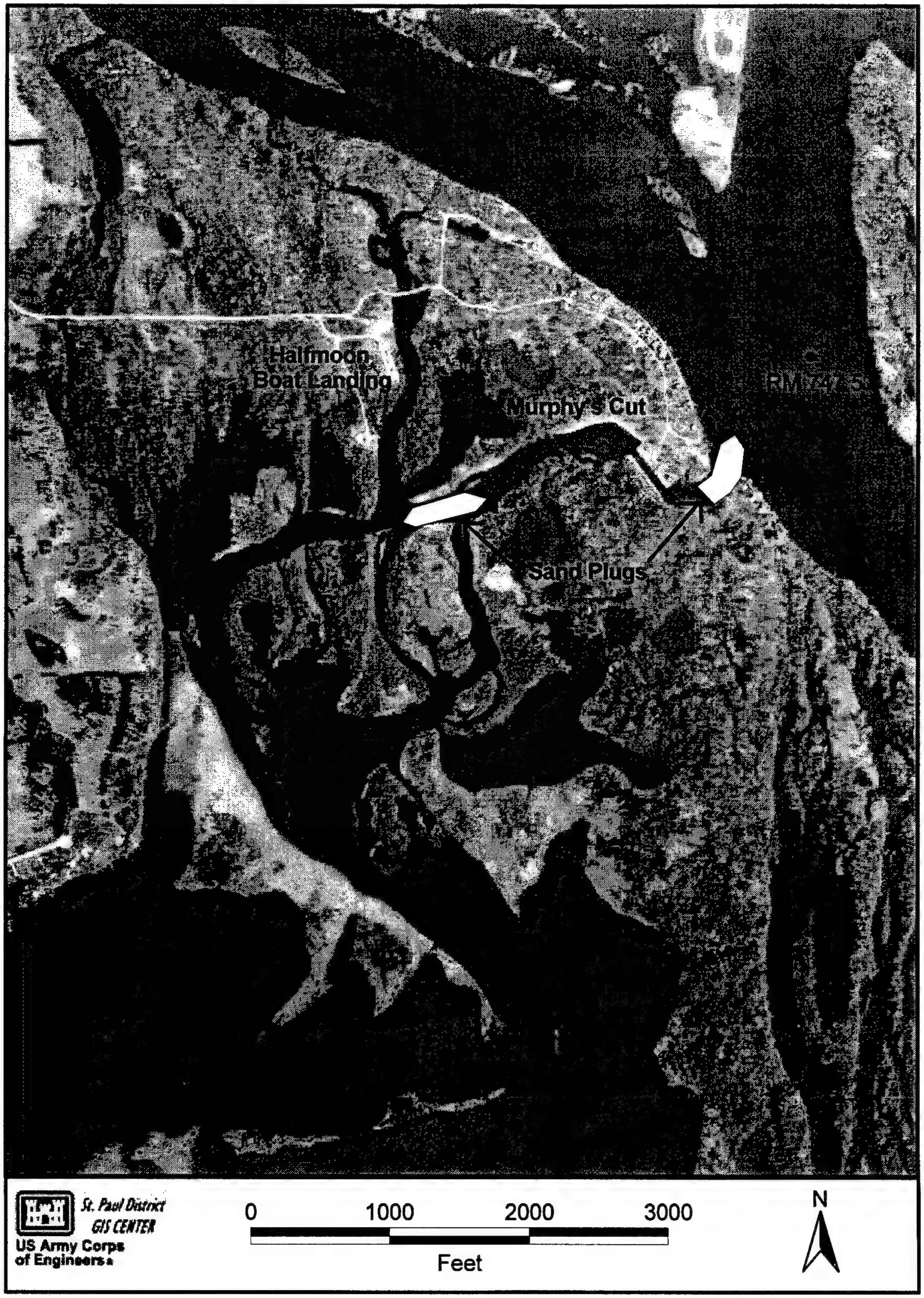


Plate 16. Half Moon Landing Area

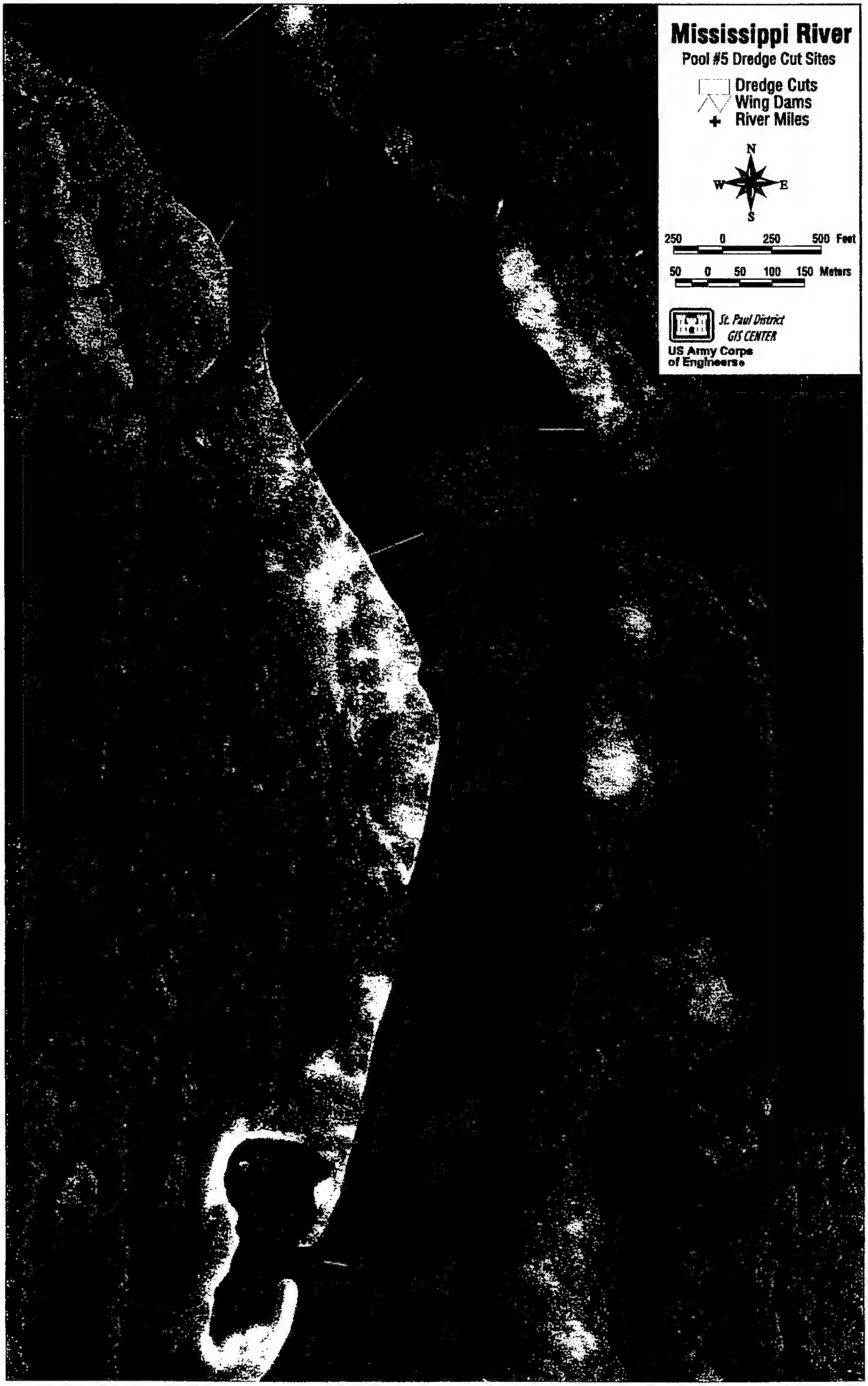
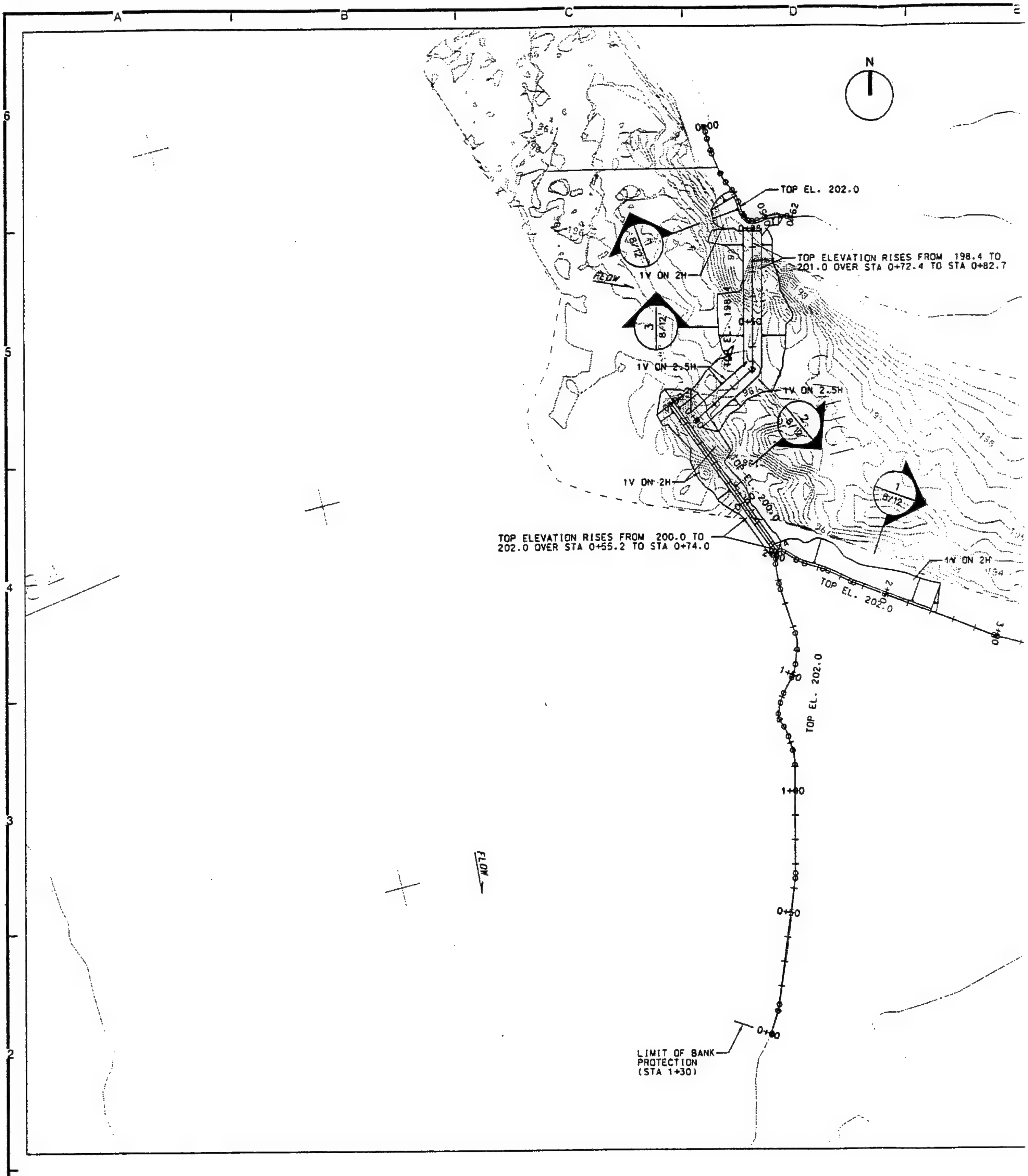


Plate 17. Below West Newton Dredge Cut



PLAN
ROEBUCKS RUN

20 0 60
SCALE IN METERS

NOTES:

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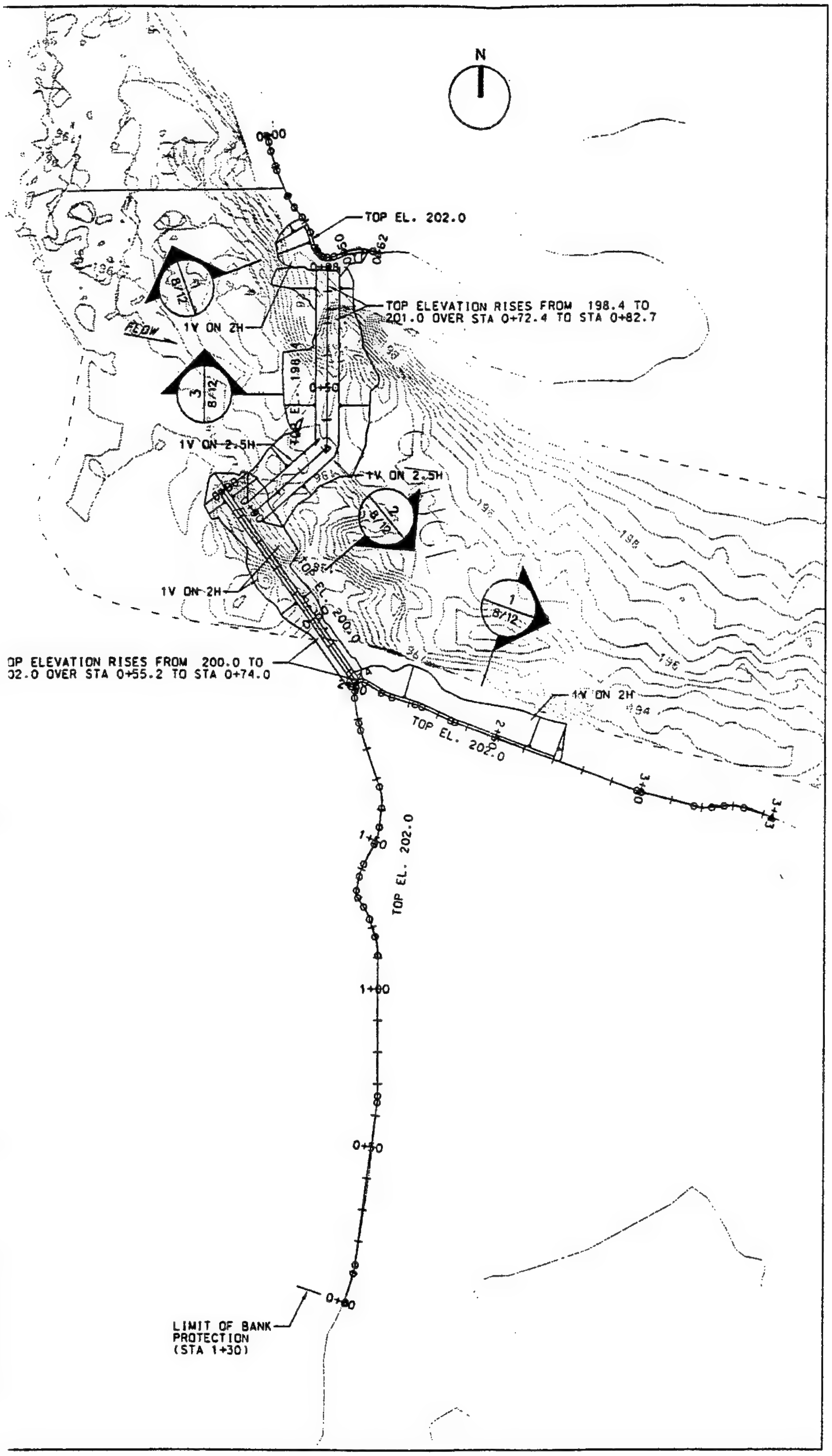
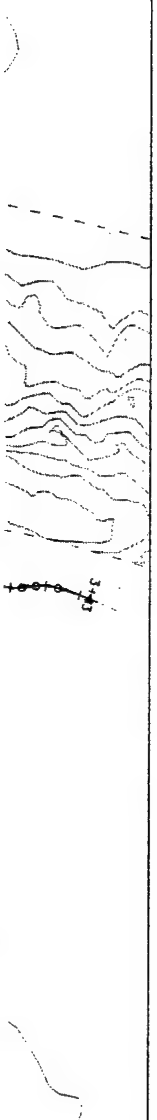


PLAN
ROEBUCKS RUN

0 60
SCALE IN METERS



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2. CONTOUR INTERVAL IS 0.5M.

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SITE WORK
PLAN
ROEBUCKS RUN

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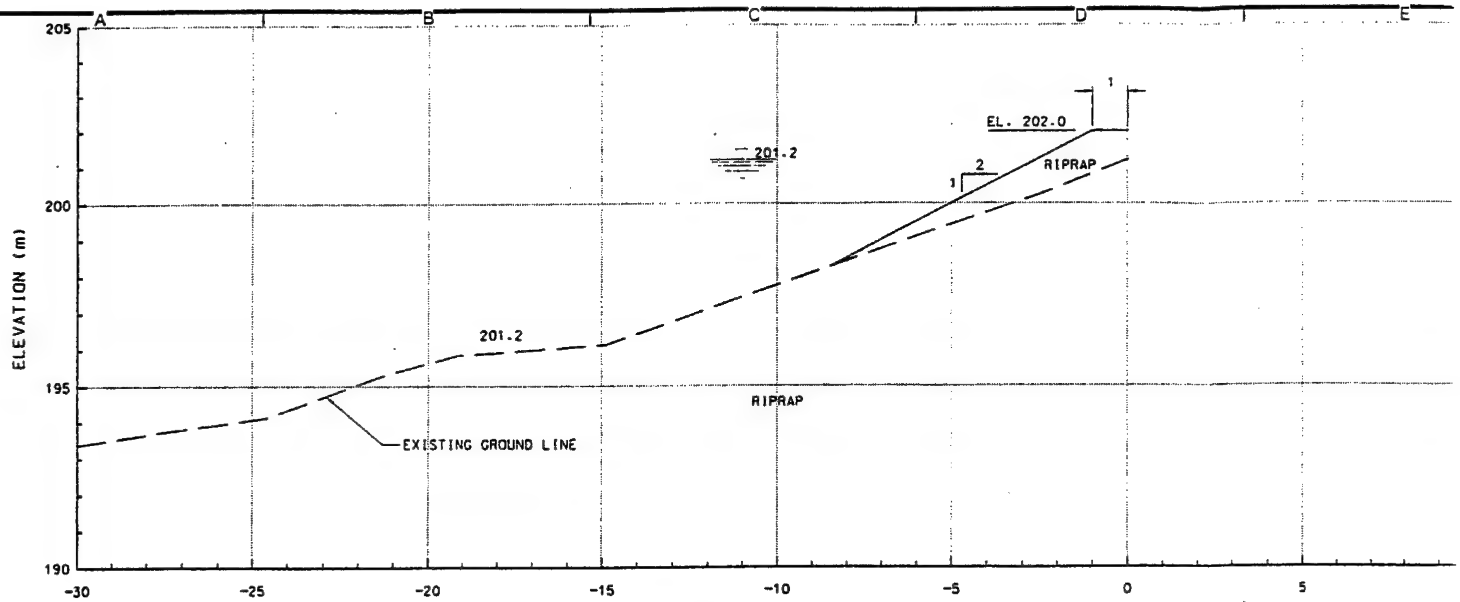
SHT 7 OF 12

Plate 18



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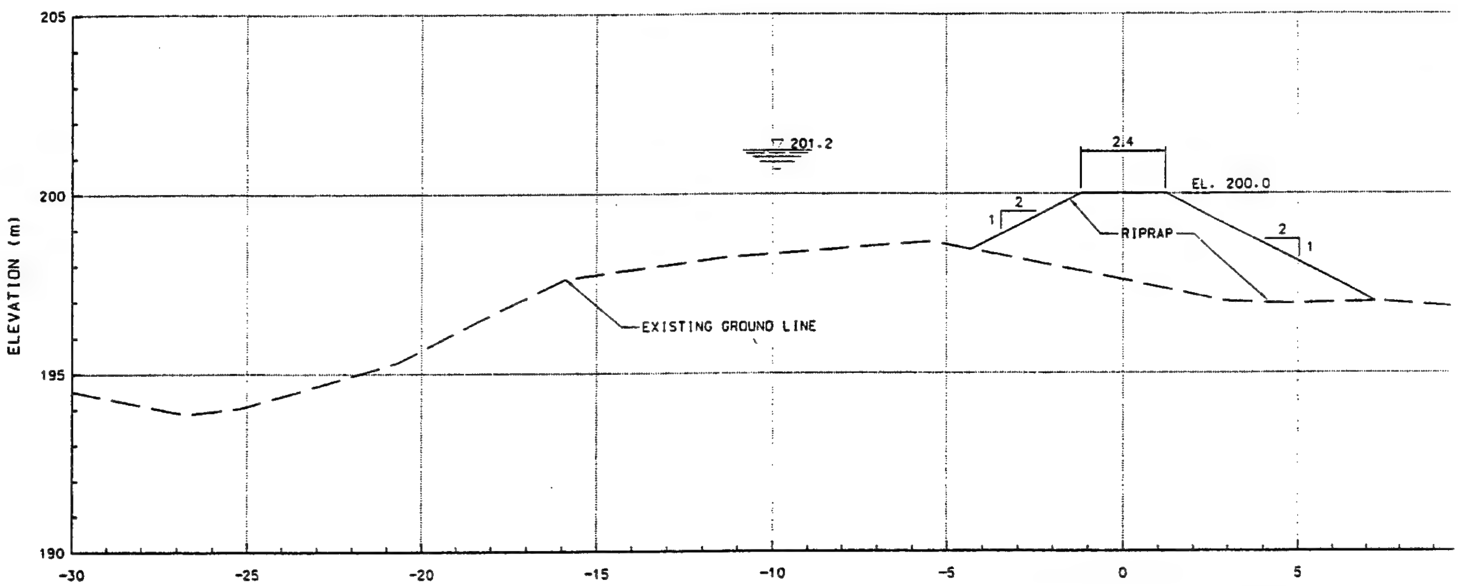
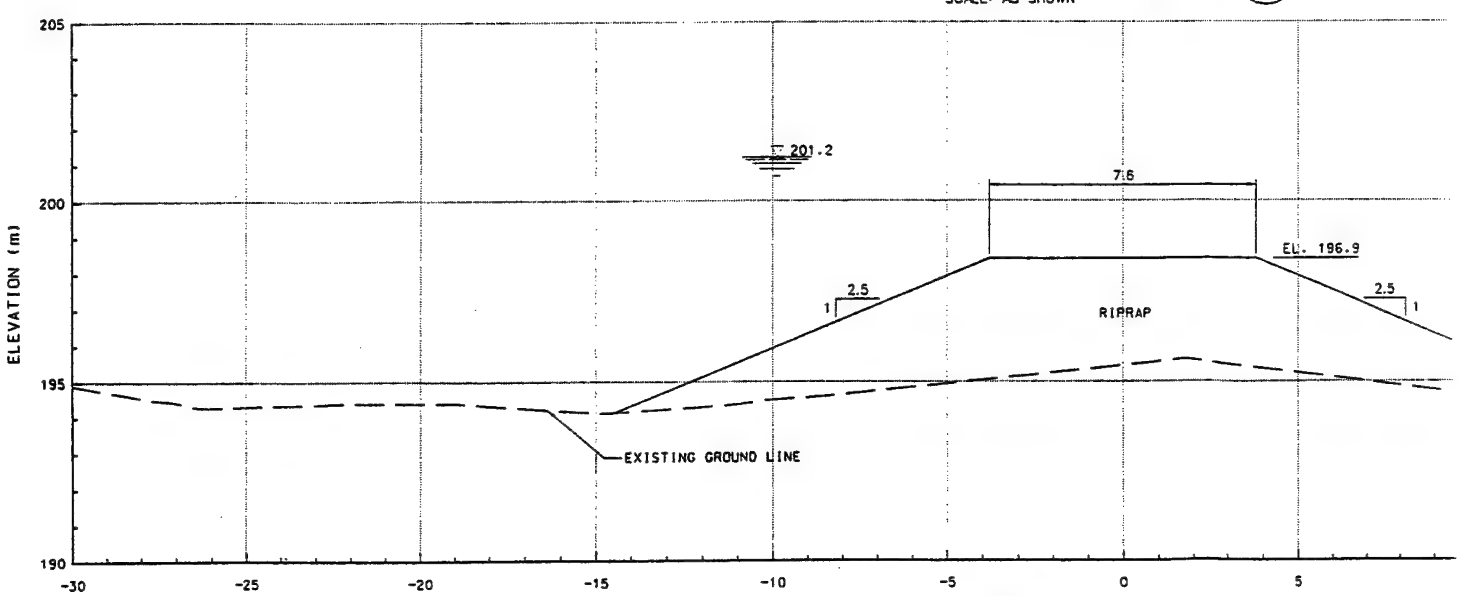
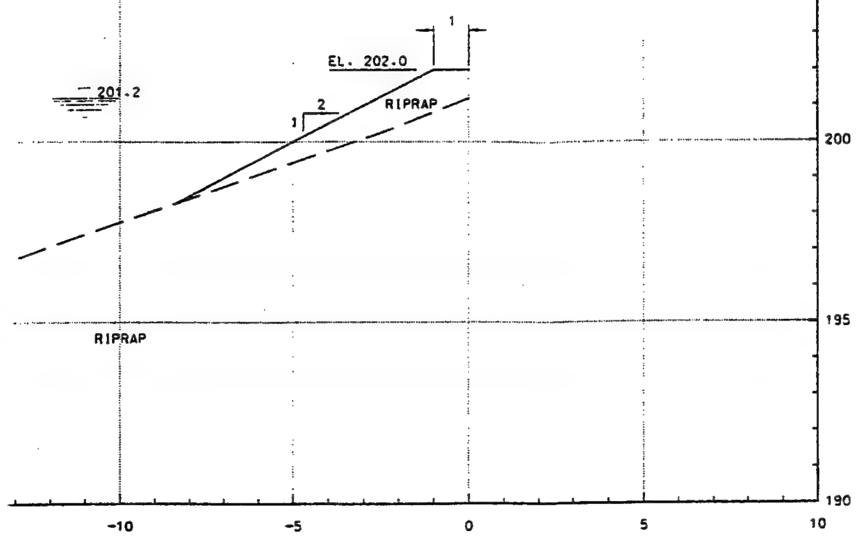


SECTION 2 7/12
DAY MARK WING DAM REHAB
SCALE: AS SHOWN



SECTION 3 7/12
ROCK LINER
SCALE: AS SHOWN



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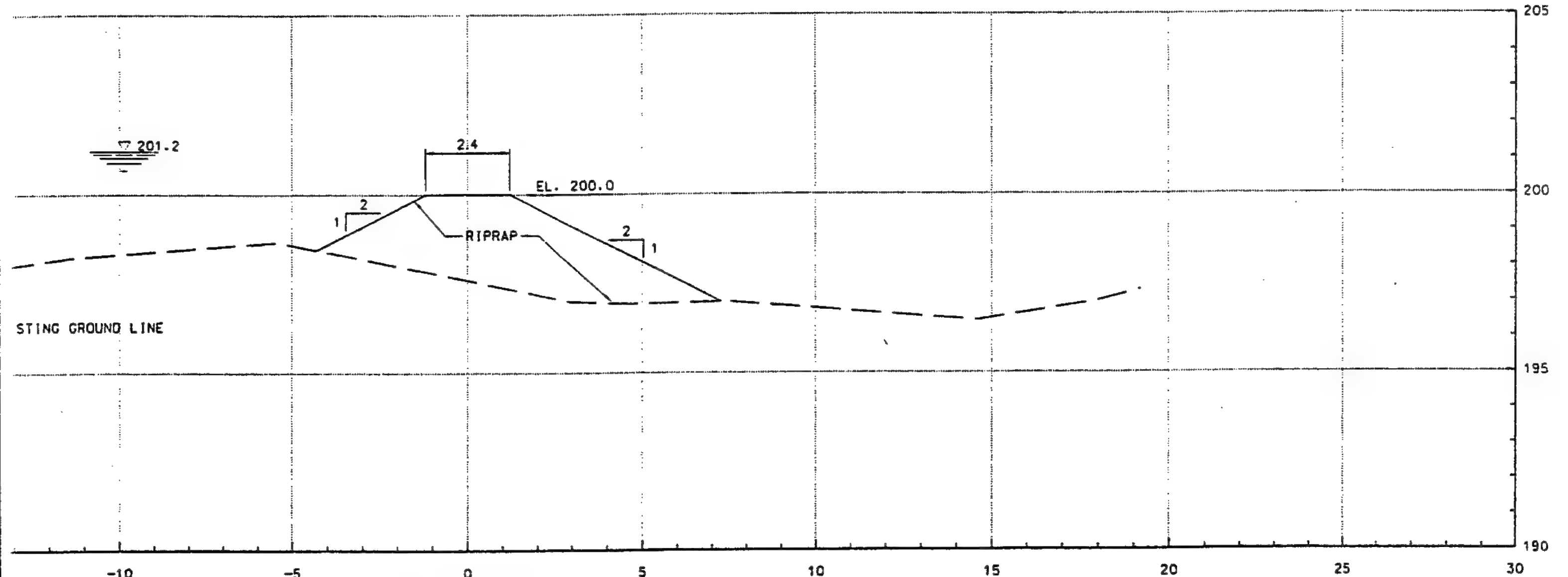

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DAY MARK WING DAM REHAB
SCALE: AS SHOWN
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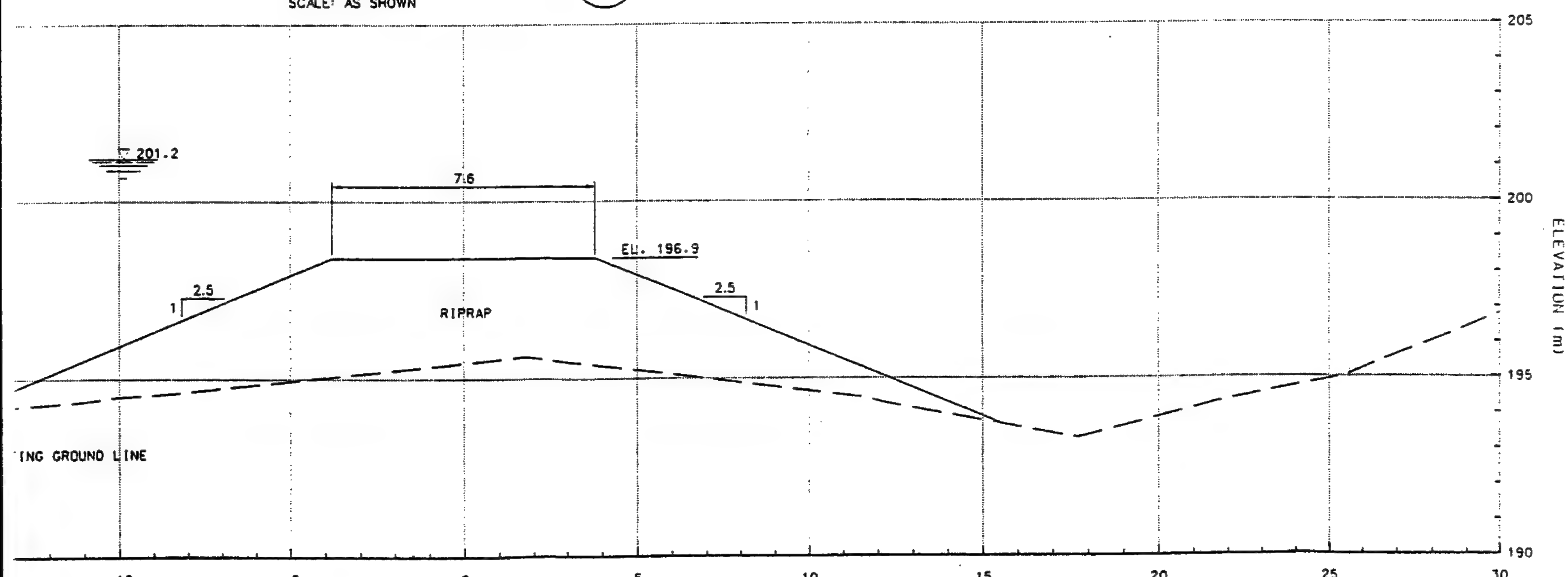

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ROCK LINER
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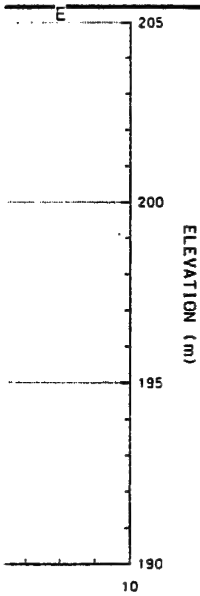

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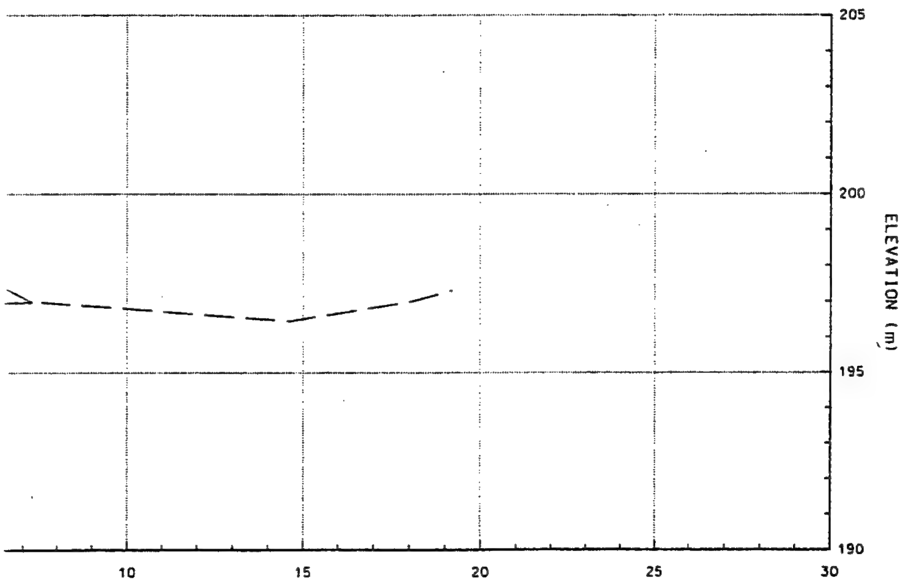

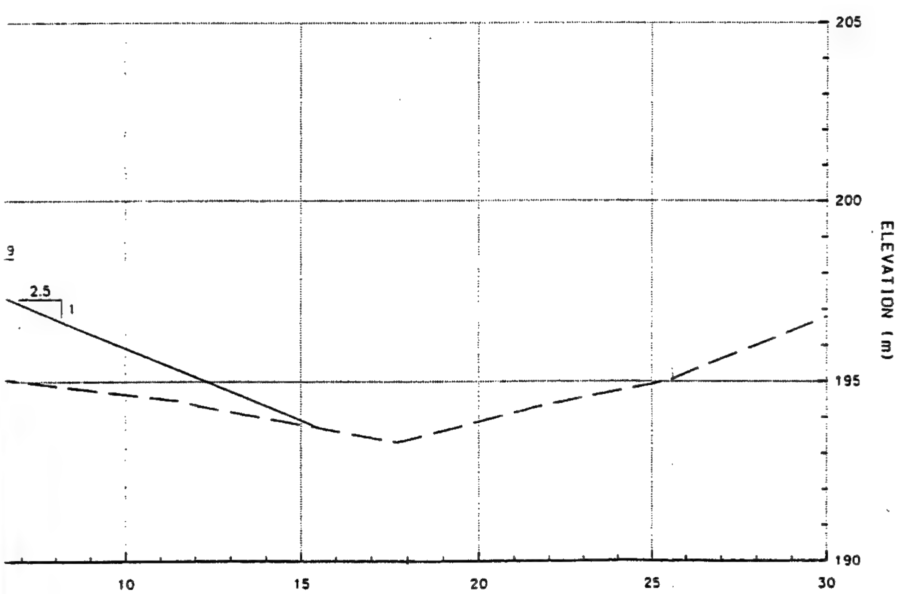

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SITE WORK
TYPICAL SECTIONS
ROEBUCKS RUN

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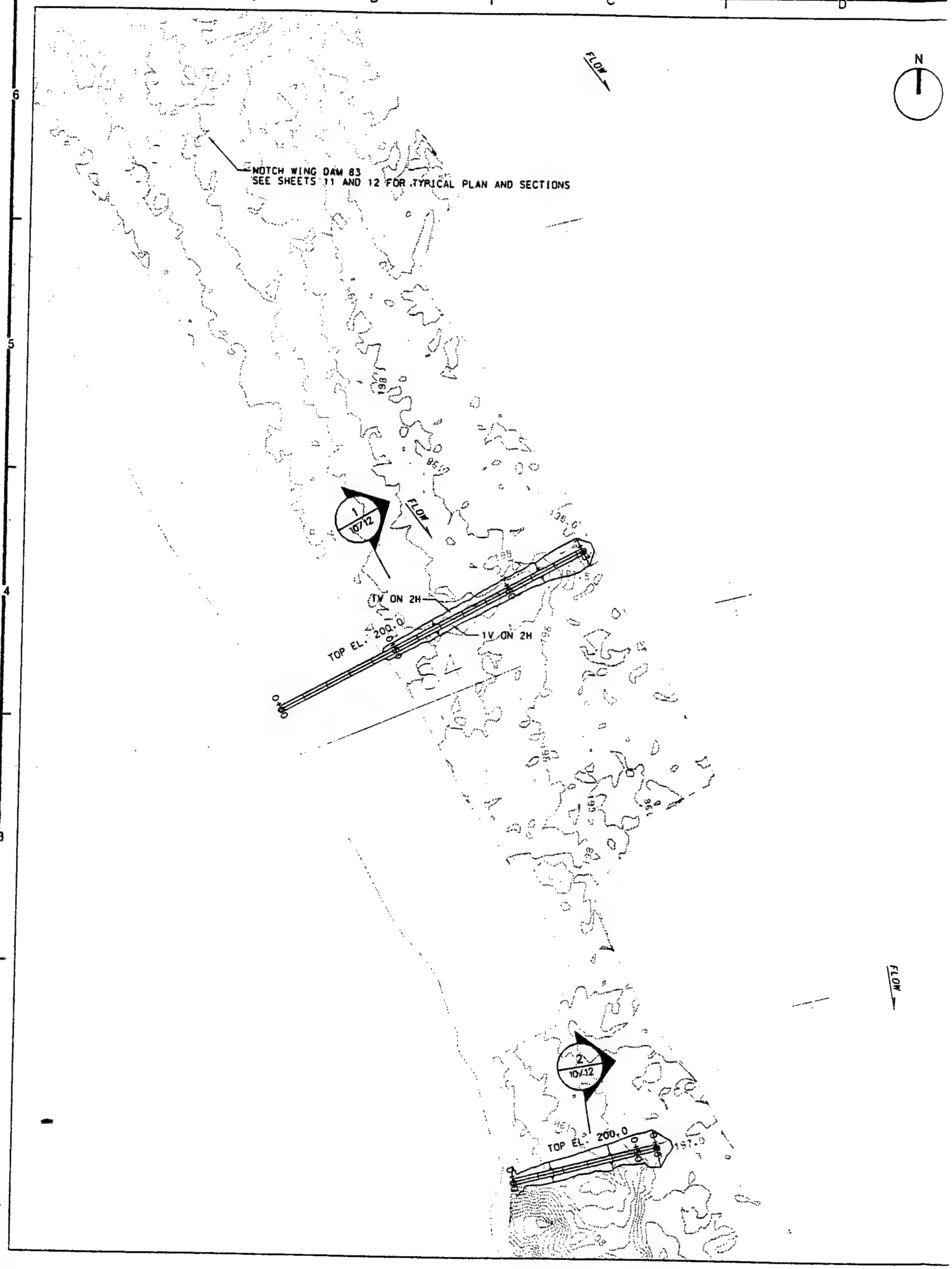
Plate 19

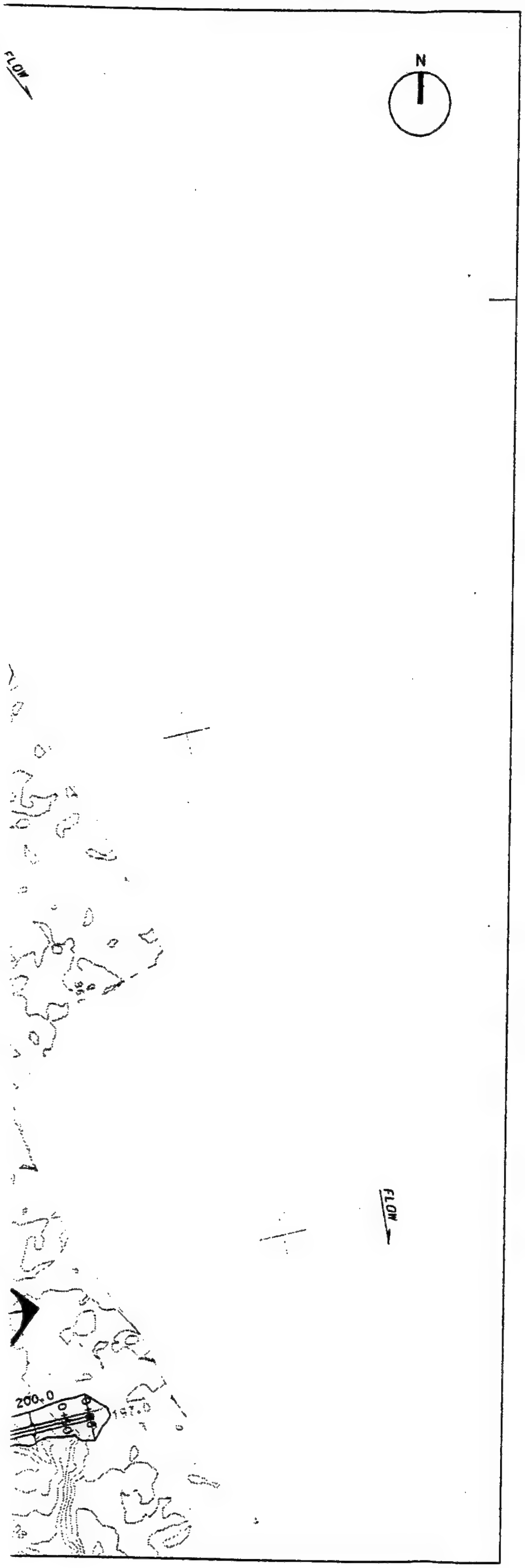


PLAN

WING DAMS 83, 84, 85

20 0 60

SCALE IN METERS



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2. CONTOUR INTERVAL IS 0.5M.

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SITE WORK
PLAN
WING DAMS 83, 84, 85

DRAWING NUMBER:
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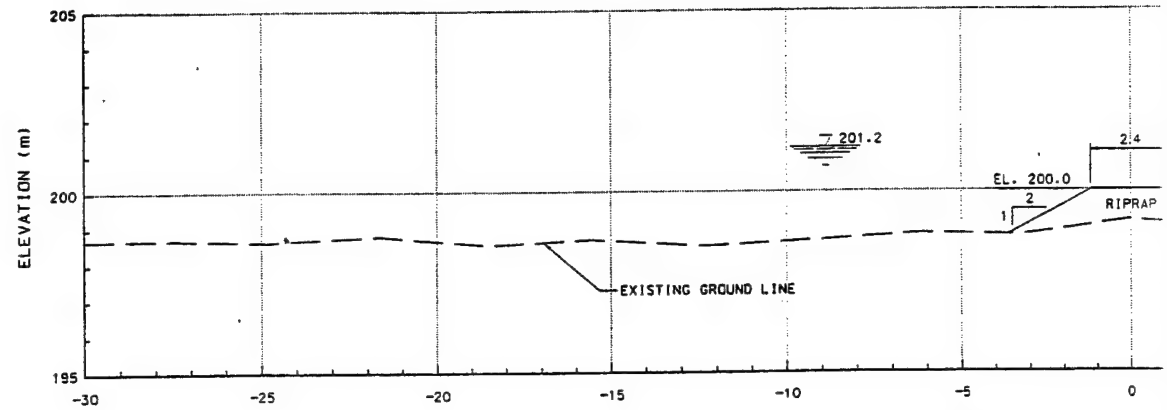
SHT 9 OF 12

Plate 20



SECTION
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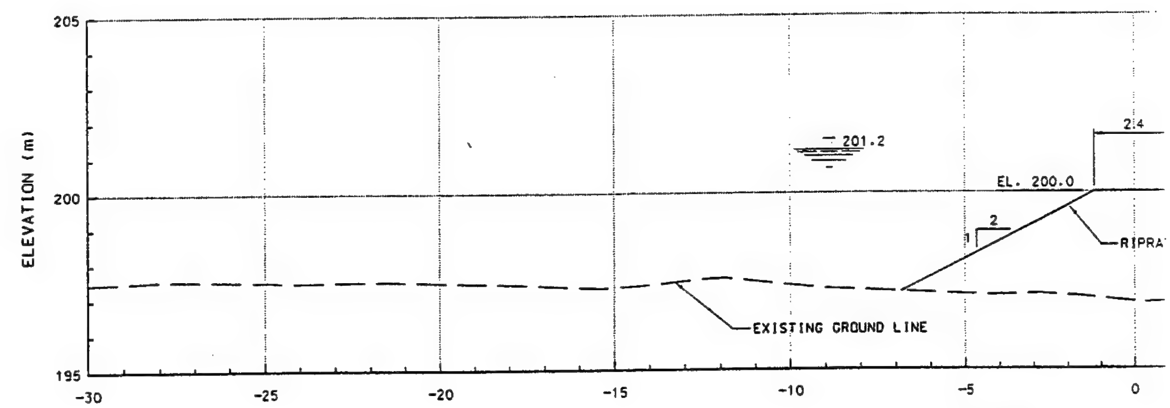

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WING DAM 85 REHAB
SCALE: AS SHOWN

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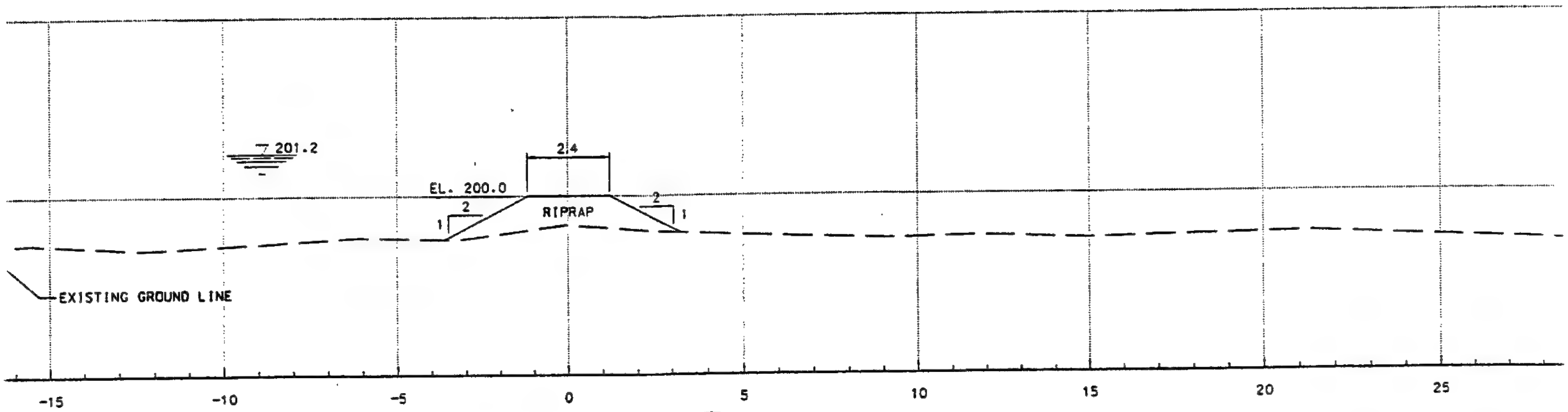
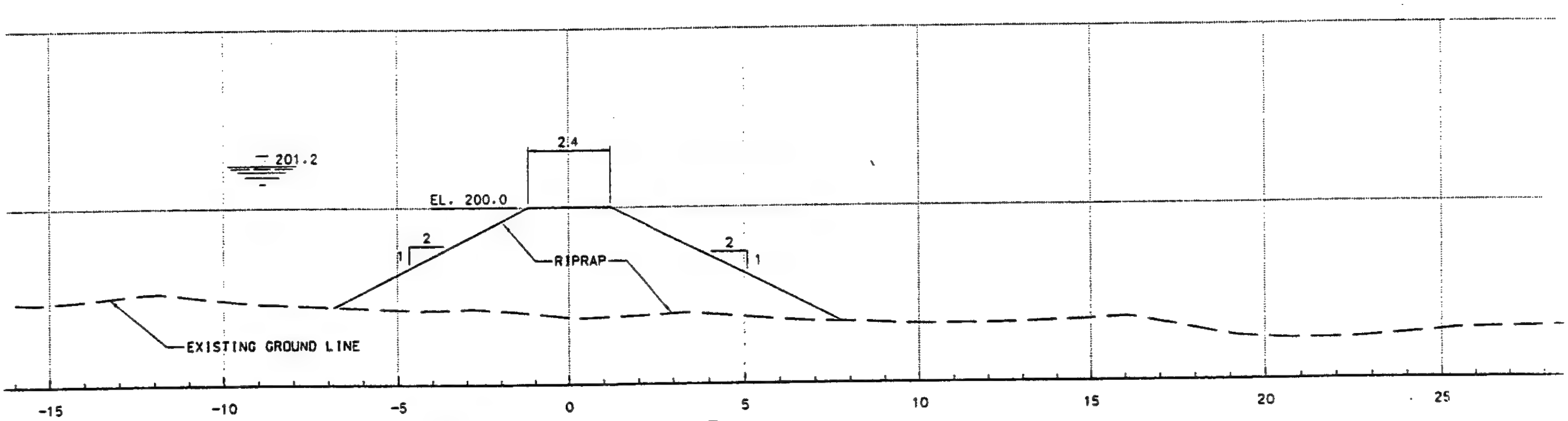


SECTION 1 9/12
WING DAM 84 REHAB
SCALE: AS SHOWN



SECTION 2 9/12
WING DAM 85 REHAB
SCALE: AS SHOWN

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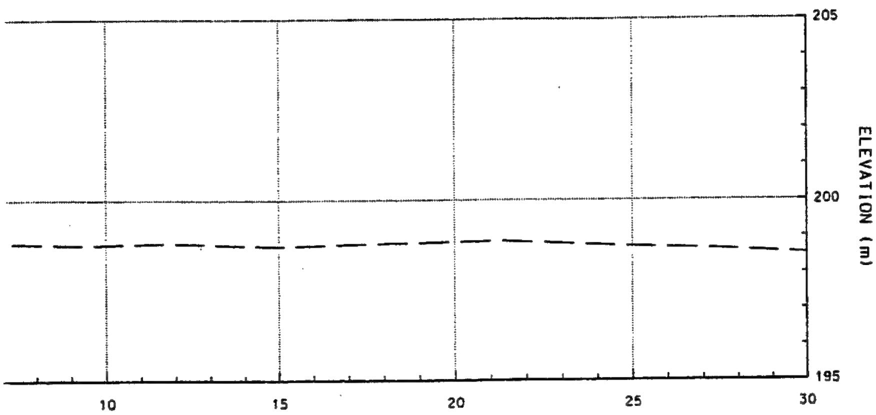

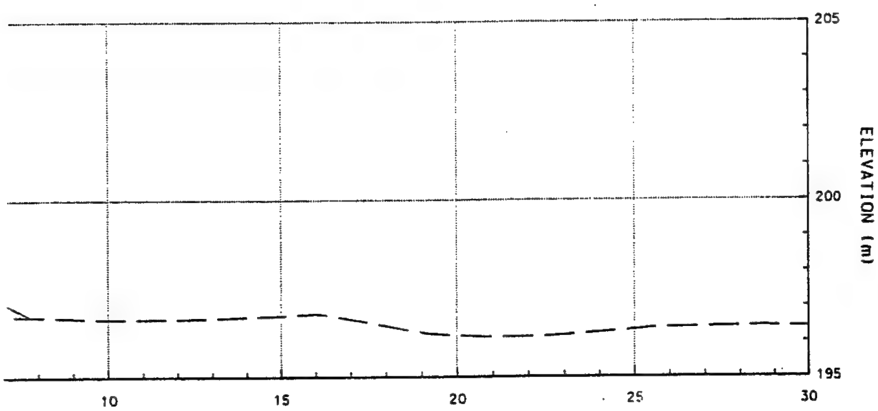

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SITE WORK
TYPICAL SECTIONS
WING DAMS 83, 84, 85

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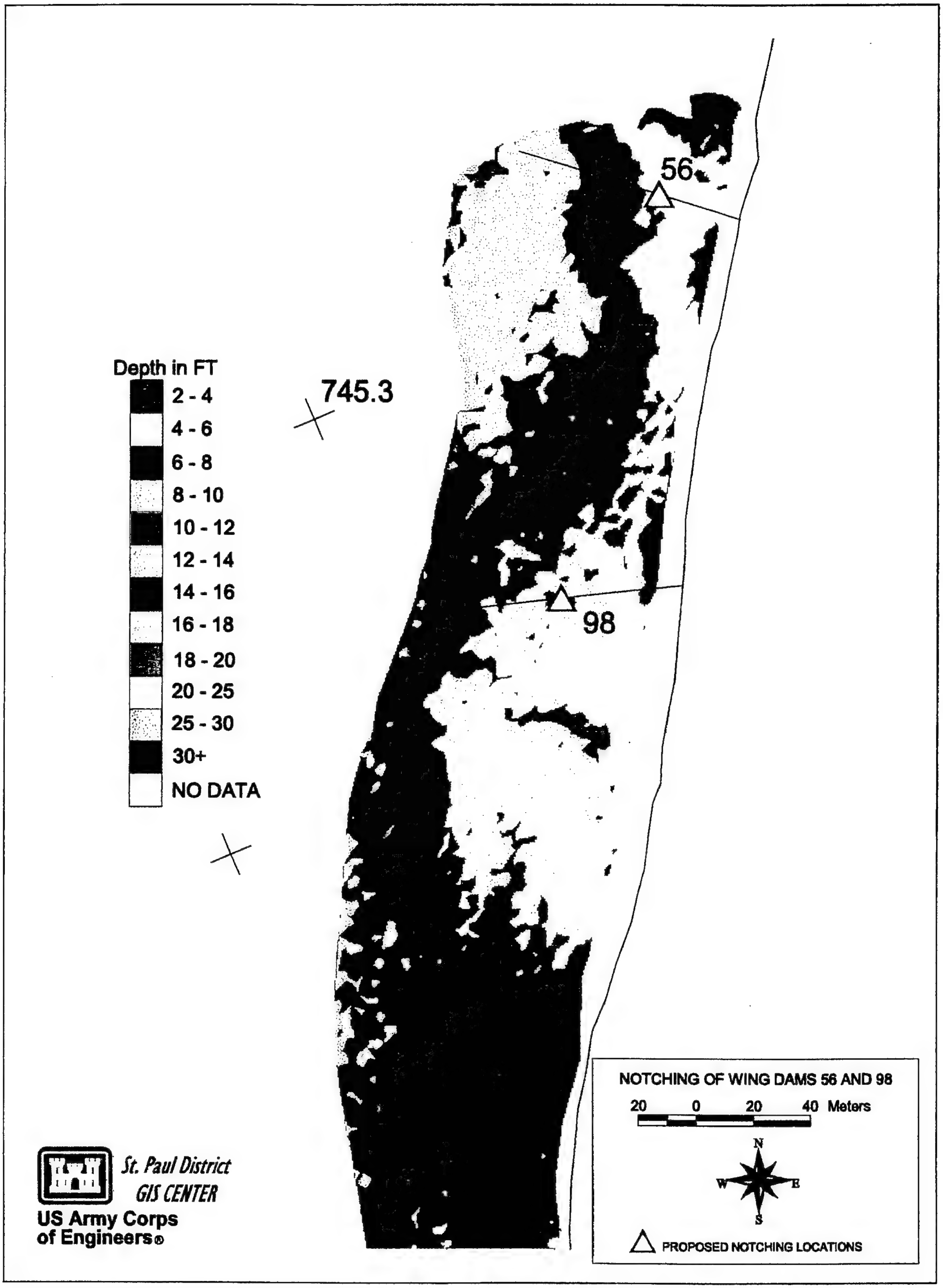
SHT 10 OF 12

Plate 21


Depth in FT
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12
12 - 14
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16 - 18
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St. Paul District
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NOTCHING OF WING DAMS 56 AND 98
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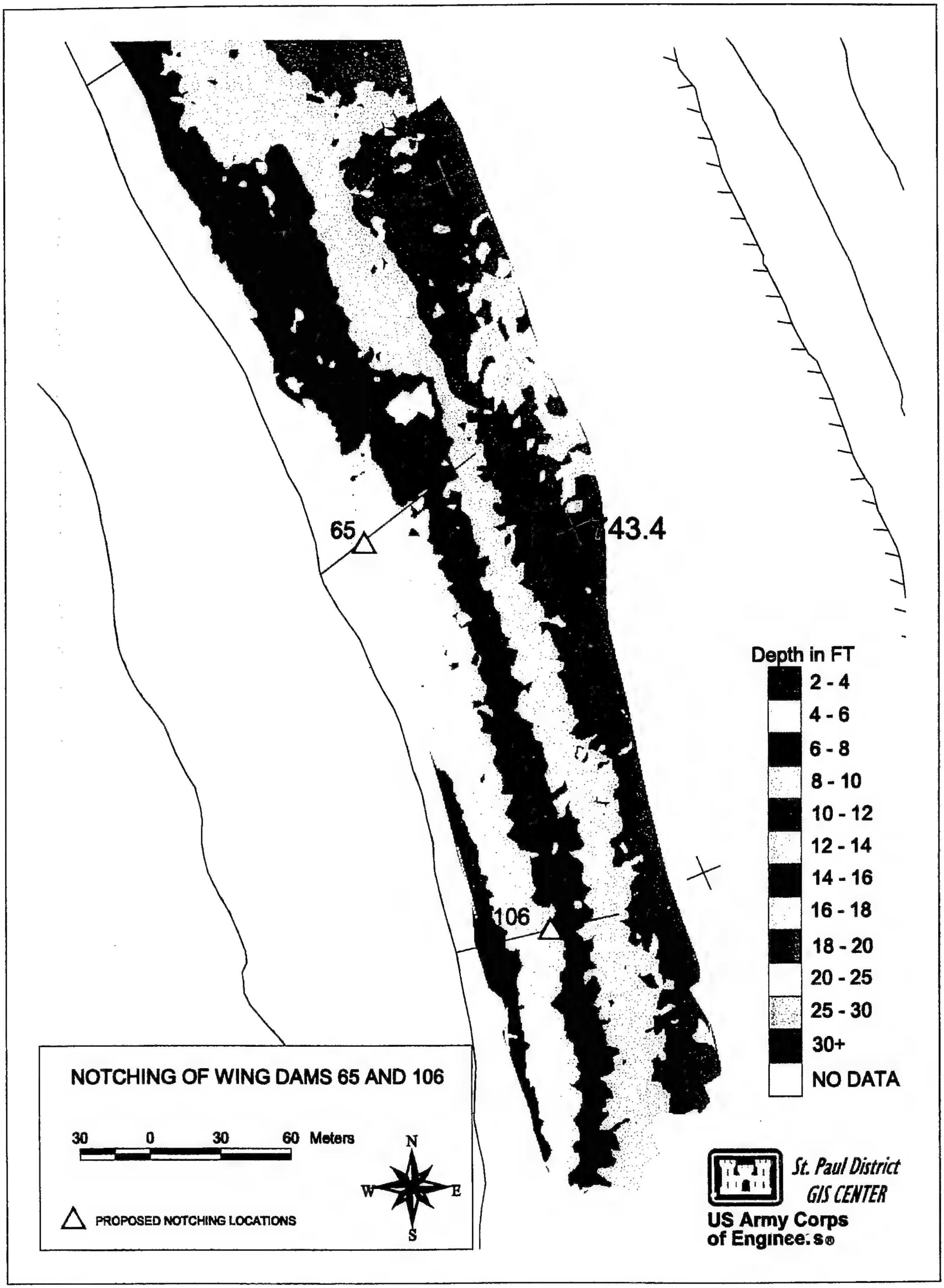
PROPOSED NOTCHING LOCATIONS


65
43.4
106
Depth in FT
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PROPOSED NOTCHING LOCATIONS
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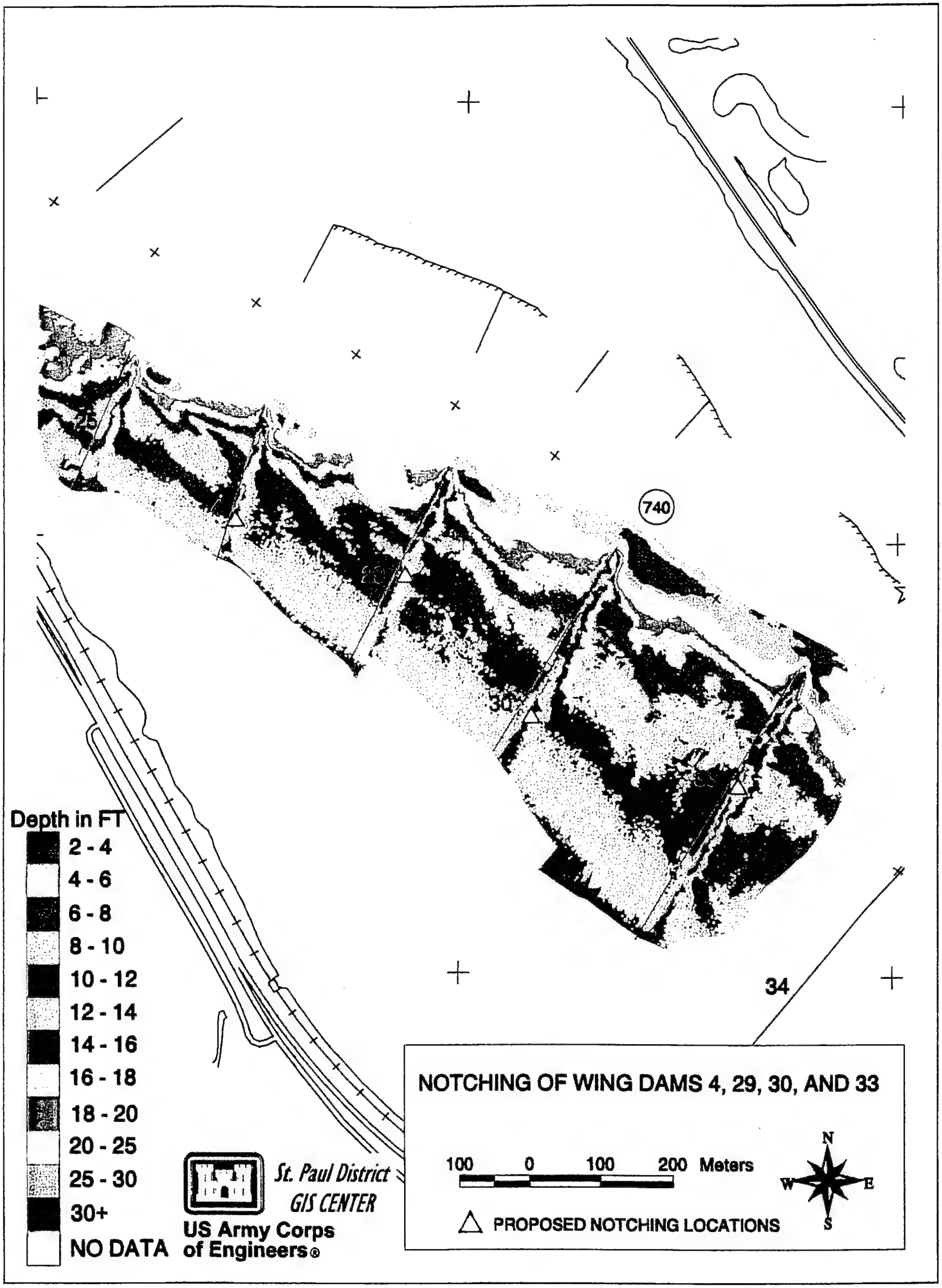
GIS CENTER
US Army Corps
of Engineers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Depth in FT
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16 - 18
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30+
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NOTCHING OF WING DAMS 4, 29, 30, AND 33
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PROPOSED NOTCHING LOCATIONS

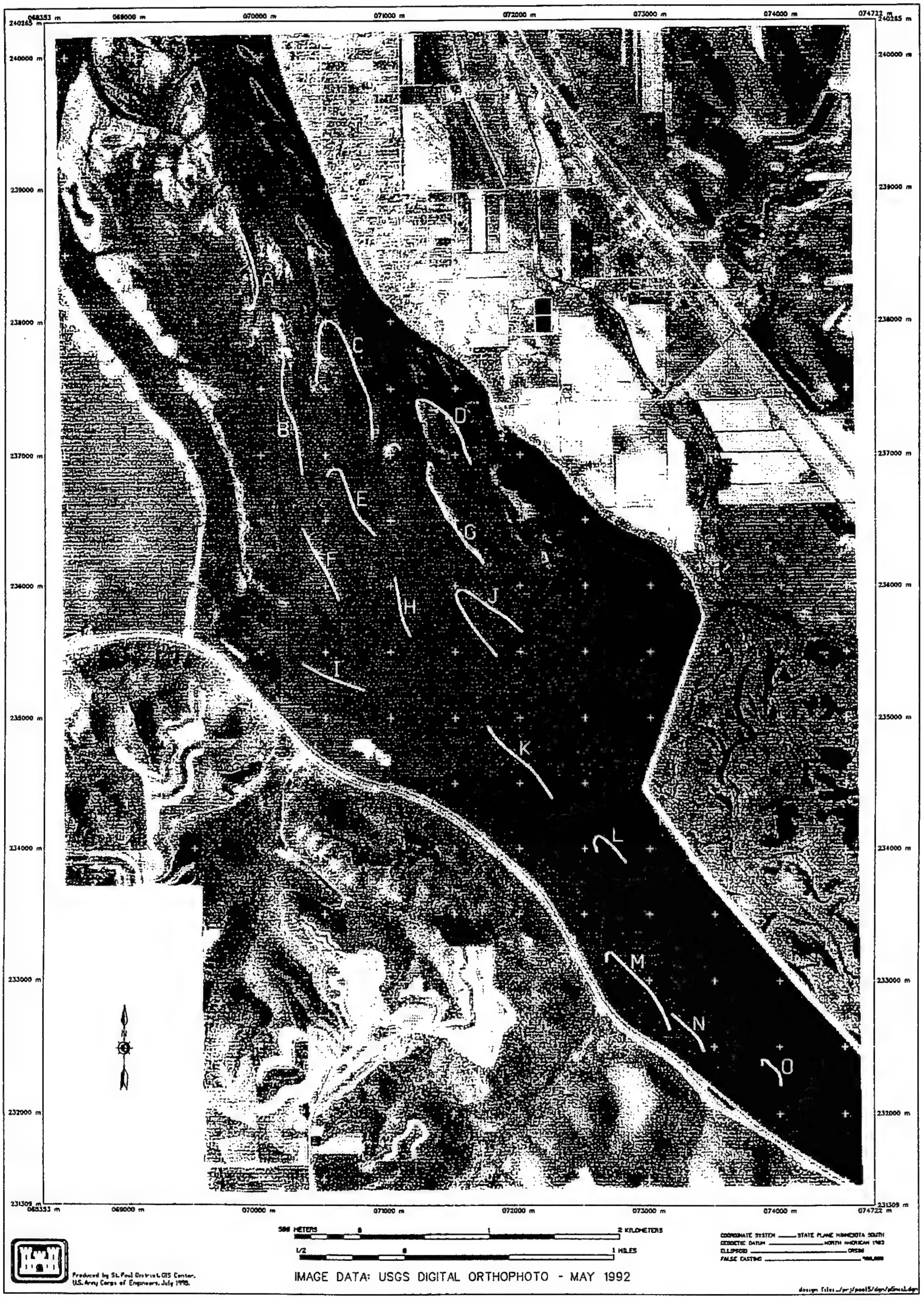


Plate 25. Conceptual Island Restoration Plan

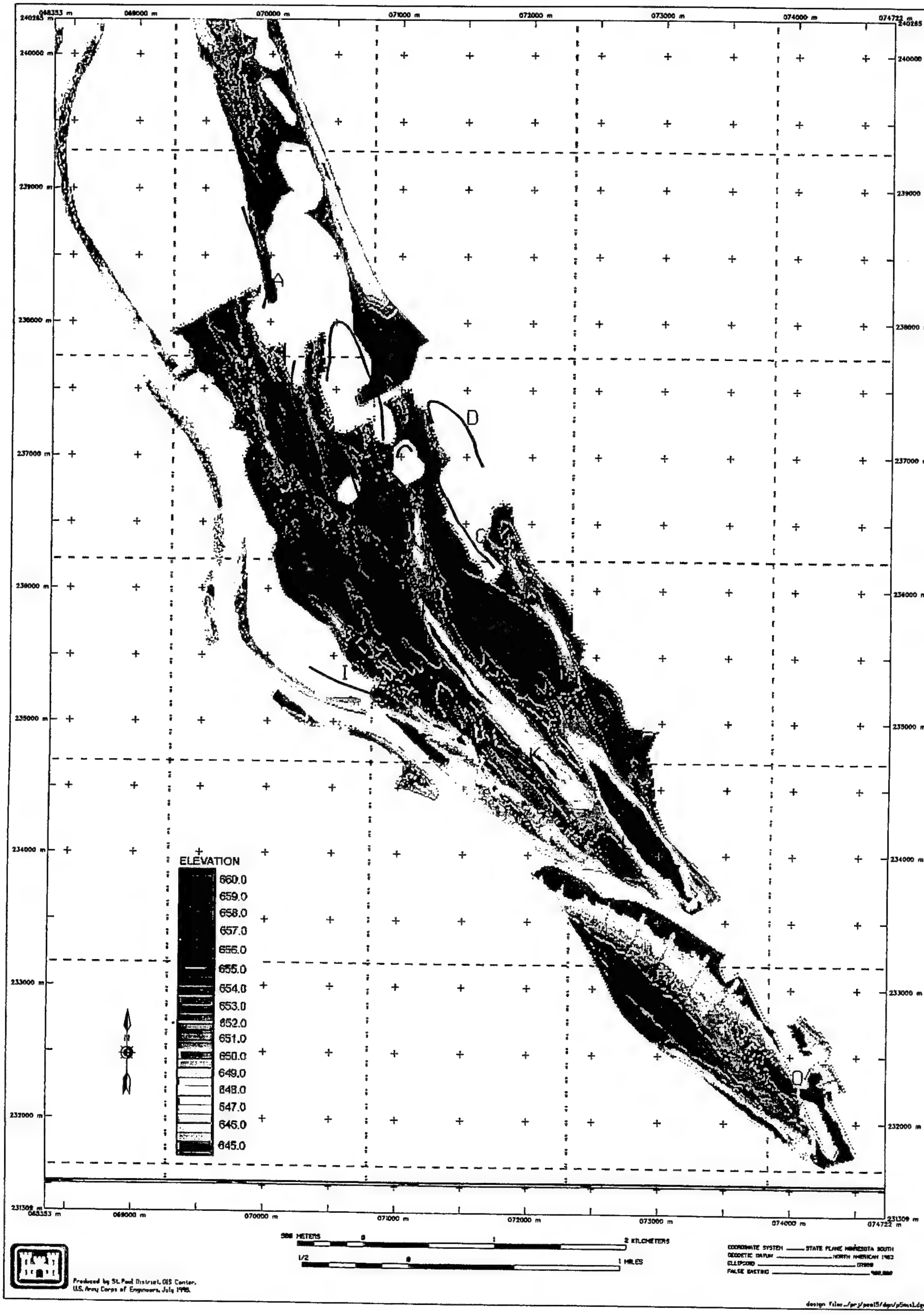
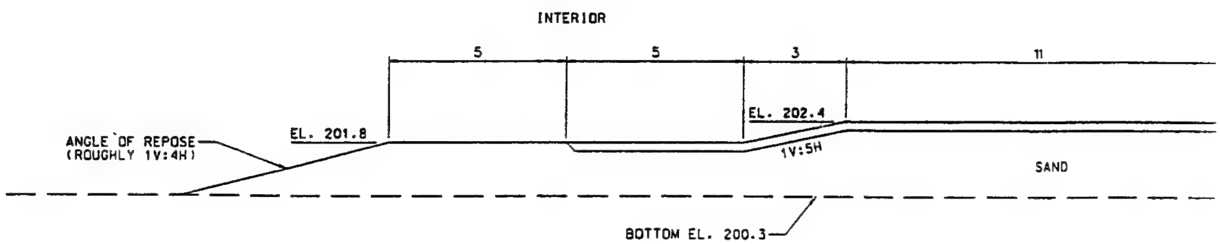
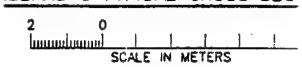


Plate 26. Conceptual Island Restoration Plan Overlaid on Bathymetry



ISLAND J TYPICAL CROSS-SEC



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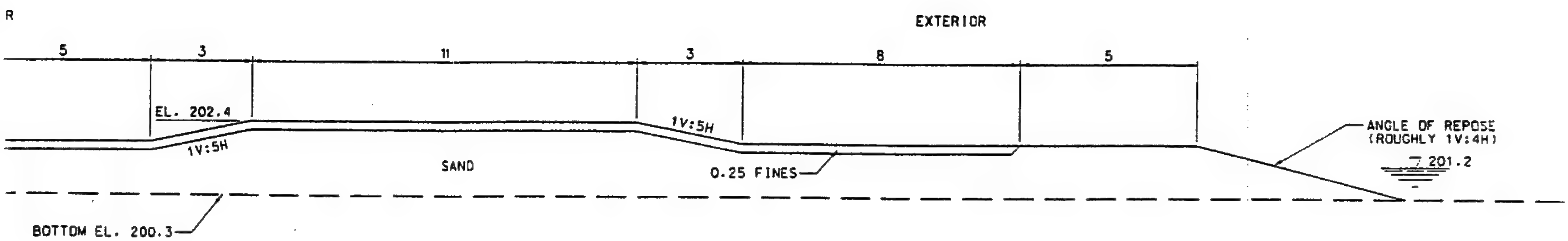

ISLAND J TYPICAL CROSS-SECTION

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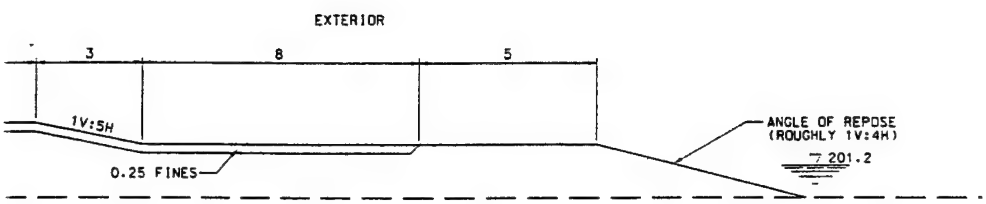
SCALE IN METERS

NOTES:

1. UNLESS OTHERWISE NOTED, UNITS SHOWN ARE IN METERS.



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POOL 5 CHANNEL MANAGEMENT STUDY
SITE WORK
TYPICAL SECTION
ISLAND J

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SHT 1 OF 1

Plate 27


068353 m
069000 m
070000 m
071000 m
072000 m
073000 m
074000 m
074722 m
240265 m
240000 m
239000 m
238000 m
237000 m
236000 m
A
B1
B2
C
D
E1
E2
E3
F
G
H
I
J

Plate 28. Location of Sn

3 Platé 28. Location of Small Island Cluster (B1, B2, E1, E2, E3)

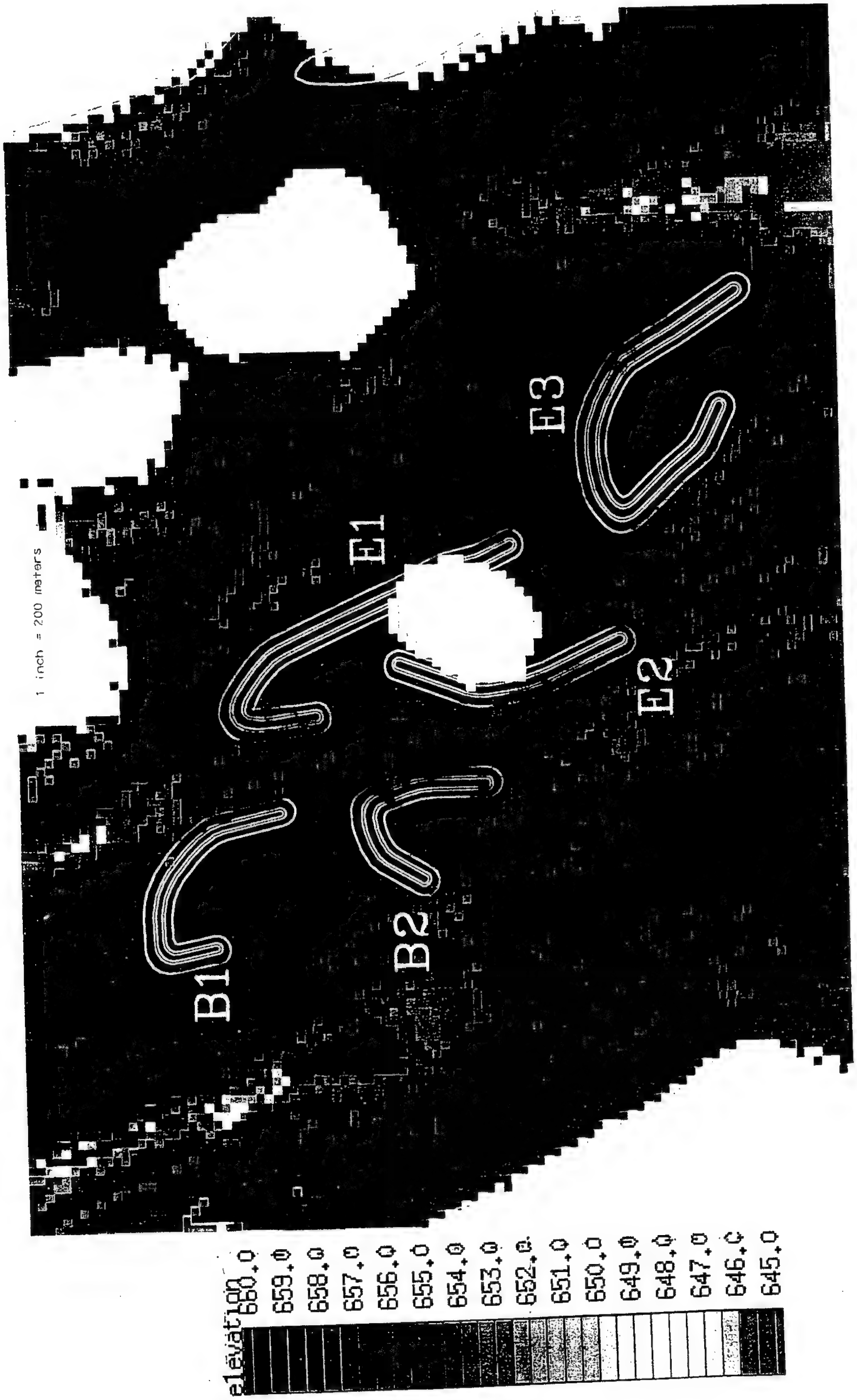
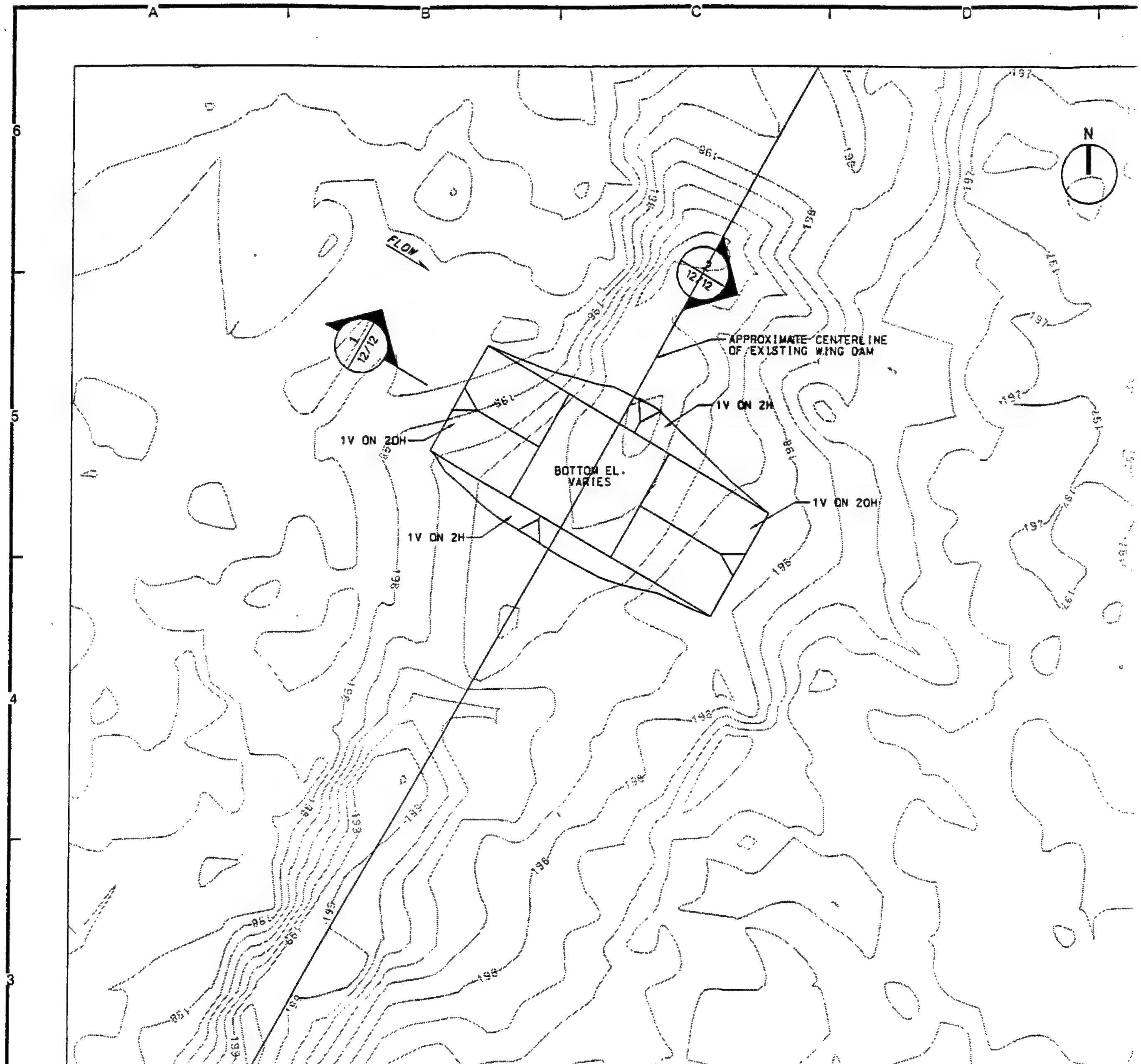


Plate 29. Layout of Small Island Cluster over Bathymetry



PLAN

TYPICAL WING DAM NOTCH

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SCALE IN METERS

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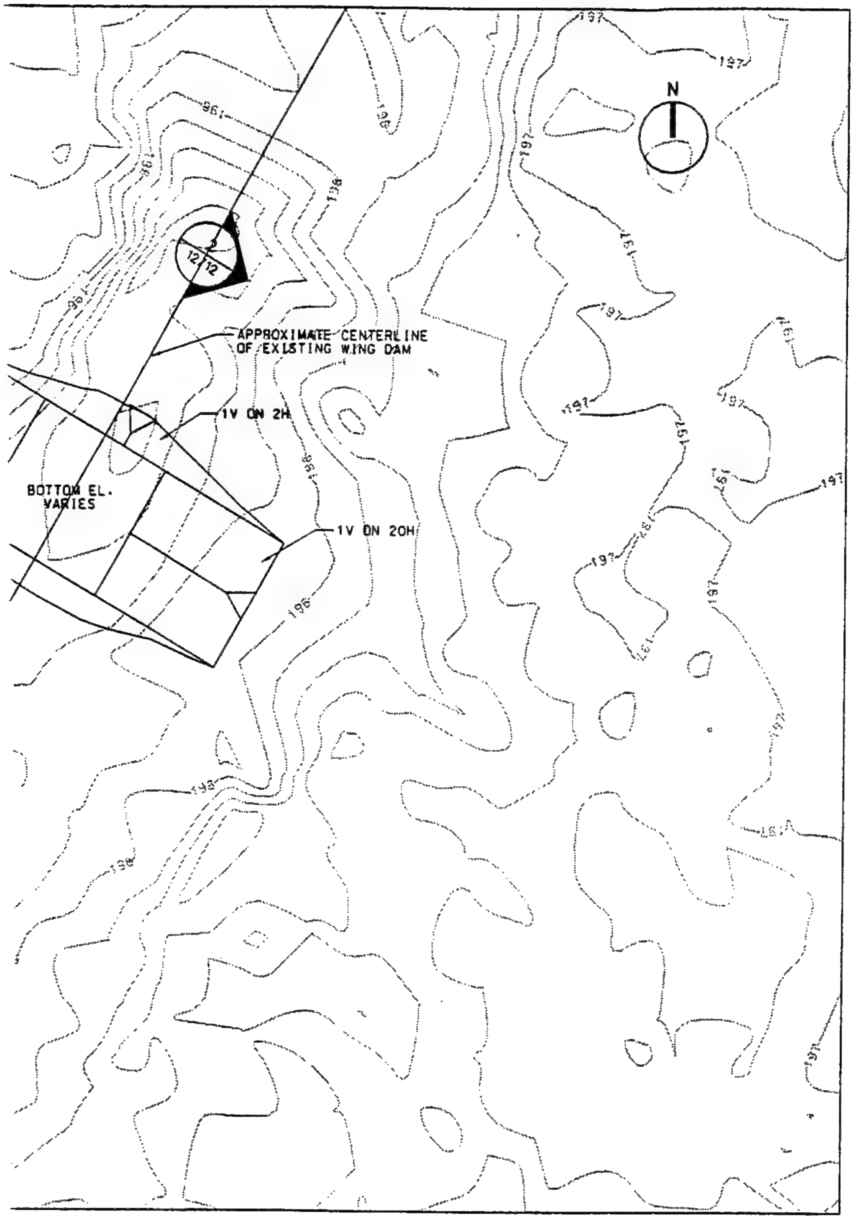

PLAN

PICAL WING DAM NOTCH

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SCALE IN METERS

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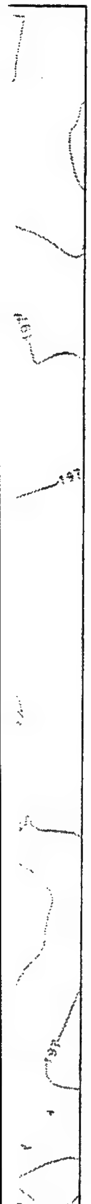

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POOL 5 CHANNEL MANAGEMENT STUDY

SITE WORK

PLAN
TYPICAL WING DAM NOTCH

DRAWING NUMBER:
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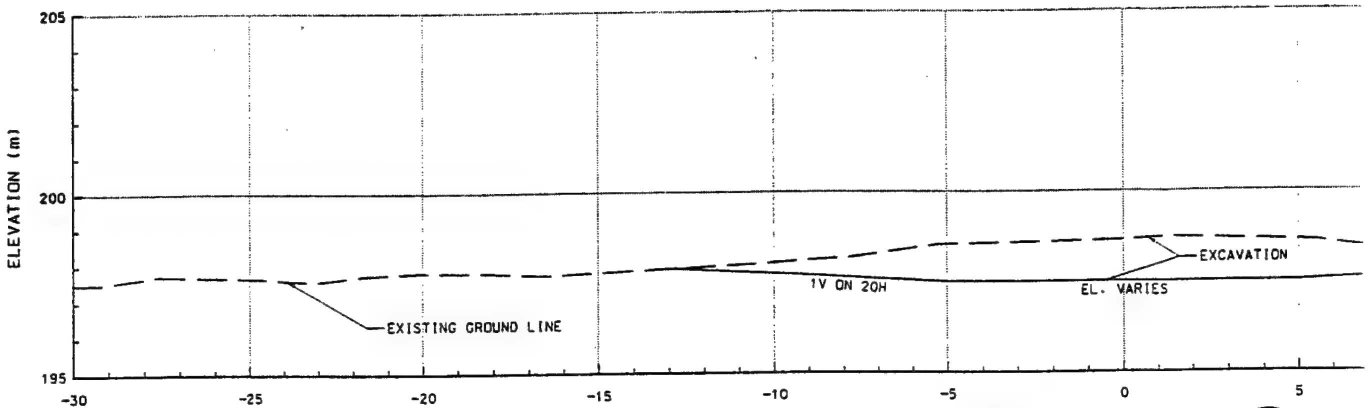
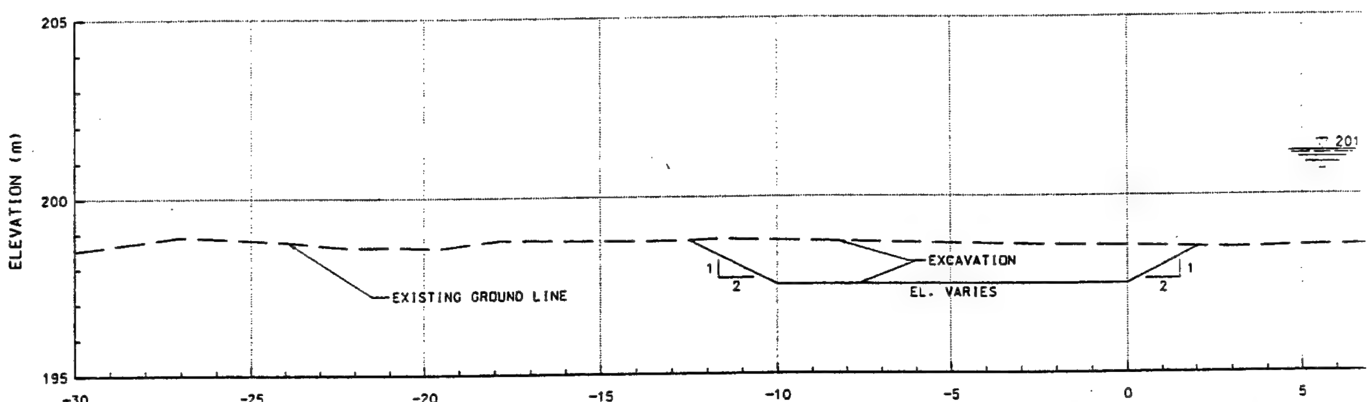
SHT 11 OF 12

Plate 30



SECTION 1 11/12
TYP. WING DAM NOTCH SECTION
SCALE: AS SHOWN



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TYP. WING DAM NOTCH SECTION
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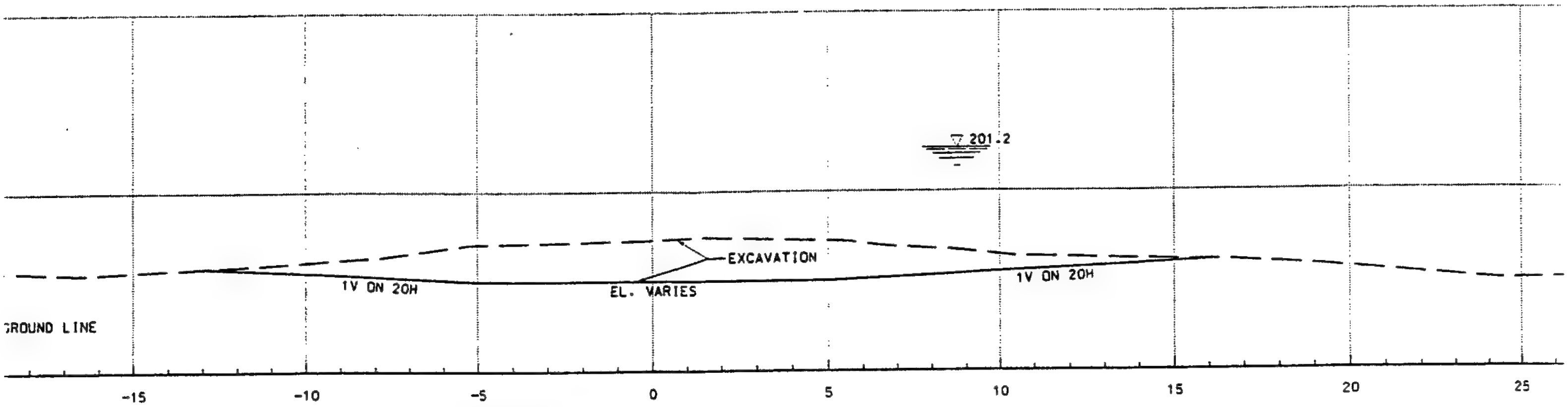

SECTION
TYP. WING DAM NOTCH SECTION
SCALE: AS SHOWN
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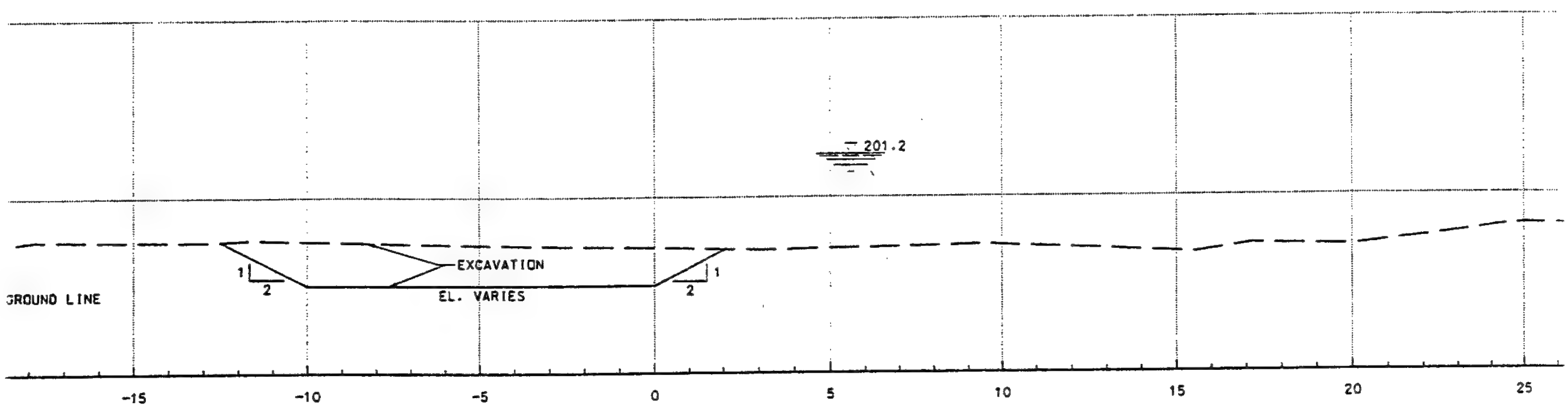
11/12



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TYP. WING DAM NOTCH SECTION
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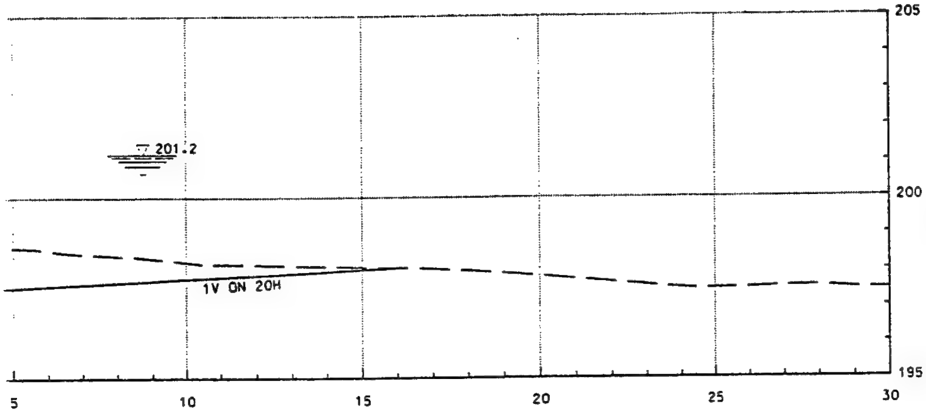

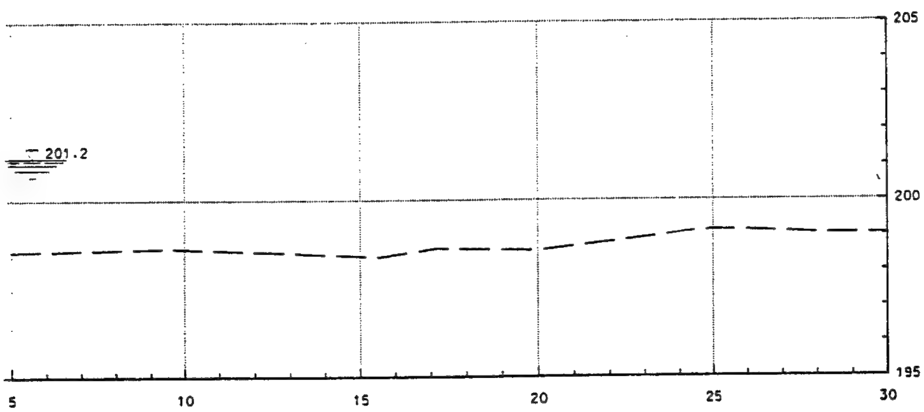

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POOL 5 CHANNEL MANAGEMENT STUDY
SITE WORK
SECTIONS
TYPICAL WING DAM NOTCH

DRAWING NUMBER:
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SHT 12 OF 12

Plate 31

Appendix A

IHET Guidelines

INTERAGENCY HYDRAULIC EVALUATION TEAM

GOAL / OBJECTIVES / GUIDELINES

MAY 9, 1996

GOAL - Improve water and sediment management on the Upper Mississippi River so that a high quality riverine ecosystem is sustained, enhanced, or restored.

OBJECTIVE A - Establish guidelines so that hydrodynamic and sediment transport studies associated with future projects on the Upper Mississippi River:

- recognize the river as a continuous hydrologic and sediment transport system affecting the geomorphic and biologic attributes of the river.

- integrates all uses of the system, including fish and wildlife, commercial navigation, recreation, and riparian uses; so that mutually beneficial activities are pursued and sustainable multiple use is maintained while protecting ecological integrity.

- identify geomorphic trends so projects utilize hydrologic and sediment transport processes to produce desireable biologic and geomorphic responses .

- build on existing knowledge obtained through experience and research so that project design is optimized, understanding of the river is increased, and river management is improved.

OBJECTIVE B - Increase the understanding of Upper Mississippi River hydrodynamics, and sediment transport so that biologists, engineers, managers, and others can make better decisions regarding management of the river.

GUIDELINES FOR OBJECTIVE A

GUIDELINE 1 - Establish primary projects based on identified need or opportunity.

GUIDELINE 2 - Establish study area boundaries, and hierarchical subareas within the study area, based primarily on hydrodynamic and sediment transport processes affecting the primary projects and on project impacts. Flexibility should be built into study area boundaries so that adjustment can be made based on multiple use goals or if interim study results support reducing or expanding boundaries.

GUIDELINE 3 - Identify multiple use goals and opportunities in the study area such as those related to fish and wildlife habitat, navigation channel maintenance, and recreation. Hydrologic connectivity goals (ie. the amount of water exchange between backwater areas and the navigation channel) should be established. Identify goals and opportunities that are mutually beneficial. While funding and authority limitations may limit the ultimate project scope during construction, the study should transcend these limitations and consider all uses of the river.

GUIDELINE 4 - Develop a list of options for achieving goals emphasizing options that achieve multiple goals. Sustained ecological integrity and multiple use should be the primary factors considered in choosing options.

GUIDELINE 5 - The study process should expand on past experience and incorporate new ideas and research. The study should represent a building block for understanding the entire river system and ultimately for managing the river as an ecosystem.

GUIDELINE 6 - Riverine processes occurring in the study area, associated with hydrodynamics and sediment transport, should be identified and analyzed. Different levels of analysis can be used within subareas of the study area. If project impacts or riverine processes affecting the project are significant, hydrodynamic and sediment transport analysis should be quantitative, incorporating state of the art data collection and numerical or physical modeling (given the limits of existing knowledge and technology). Cumulative changes to the study area due to recent (ie. the last 20 years) activities should be quantified.

GUIDELINE 7 - Geomorphic trends in the river floodplain should be determined. Both the project study and past studies should be used to determine these trends.

GUIDELINE 8 - Identify opportunities for projects to work with desireable geomorphic trends and riverine processes to achieve environmental and economic sustainability.

GUIDELINE 9 - A system-wide integrated study approach should be adopted. Activities in adjacent reaches and tributaries, or changed system operation (ie. alternative water level management) should be considered.

GUIDELINE 10 - Develop a monitoring plan based on project impacts, whether methods used to analyze the project were qualitative or quantitative, and opportunities for obtaining new information. Not every project needs a comprehensive monitoring plan.

GUIDELINE 11 - Reversibility and adjustability should be included in project design so that changes or removal can be implemented if postproject monitoring indicates this need.

Appendix B

Pool 5 Structures Inventory

WINGDAM AND CLOSING DAM SUMMARY POOL 5

DAM TYPE & NO.	MILE	LOCATION	BUILT	MODIFIED	MOD./TYPE	LENGTH	TOP ELEV.	ROCK/CY	BRUSH/CY	LUMBER/FT
SHEET # 15										
CLOSING DAM 1	748.0	LEFT	1880			200	4.0	286.8	256.2	
				1882	RAISED		5.0	893.8	584.5	
				1888	RAISED		6.0	1,139.6	400.1	
				1891	REPAIRED			790.7	746.9	
				1899	MOVED	240	4.0	2,057.1	2,133.8	
				1915	REPAIRED			378.1	236.7	
				1923	REPAIRED			134.8	313.4	
CLOSING DAM 2	748.0	LEFT	1880			750	4.0	1,312.7	1,173.5	
				1882	RAISED		5.0	1,809.2	837.2	
				1888	RAISED		6.0	698.4	461.1	
				1899	REPAIRED			999.3		
				1915	REPAIRED			1,071.8	1,055.6	
				1923	REPAIRED			1,149.6	767.7	
CLOSING DAM 3	750.3	RIGHT	1880			70	3.0	65.2	243.4	
				1882	EXTENDED	115		342.7	166.7	
				1887	REPAIRED			163.6		
				1888	REPAIRED			94.2		
				1910	REPAIRED			1,133.7	2,037.1	
				1915	RAISED		5.0	982.1	1,707.1	
CLOSING DAM 4	750.0	RIGHT	1882			75	4.0	101.6	153.2	
				1887	REPAIRED			30.1		
				1911	REPAIRED			166.9		
				1915	RAISED		5.0	330.3	487.8	
CLOSING DAM 5	752.6	RIGHT	1880			320	4.0	618.1	657.7	
CLOSING DAM 6	748.1	LEFT	1887			100	4.0	885.3	377.3	
				1891	REPAIRED			212.4	64.1	
				1915	REPAIRED			1,210.6	1,038.7	
				1923	REPAIRED			57.7	50.6	
CLOSING DAM 7	750.3	RIGHT	1887			100	3.0	623.1		
				1910	REPAIRED			1,736.9	1,023.5	
				1911	REPAIRED			80.1		
				1915	RAISED		5.0	1,793.8	2,397.9	
WINGDAM 7	748.4	RIGHT	1891			575	2.5	1,703.4	1769.4	
				1899	RAISED		4.0	355.1	1369.2	
				1915	EXTENDED	745		333.2	1,483.7	
WINGDAM 8	748.2	LEFT	1891			250	4.0	858.3	751.9	

WINGDAM AND CLOSING DAM SUMMARY POOL 5

DAM TYPE & NO.	MILE	LOCATION	BUILT	MODIFIED	MOD./TYPE	LENGTH	TOP ELEV.	ROCK/CY	BRUSH/CY	LUMBER/FT
WINGDAM 9	748.1	LEFT	1891			550	4.0	2,174.9	1,959.1	
				1899	EXTENDED	710		309.1	1,131.6	
				1923	REPAIRED			530.1	1,217.2	
WINGDAM 10	748.0	LEFT	1891			300	4.0	1,639.6	1,280.5	
				1899	EXTENDED	420		263.9	370.7	
CLOSING DAM 11	748.8	LEFT	1891			80	4.0	511.2	346.6	
				1899	RAISED		5.0	183.6	298.3	
				1923	REPAIRED			44.8	50.6	
WINGDAM 12	748.1	RIGHT	1891			550	2.5	1,444.1	1,674.3	
				1899	RAISED		4.5	359.3		
				1915	EXTENDED	650		411.3	1,357.3	
				1915	REPAIRED			50.1		
CLOSING DAM 13	748.2	LEFT	1891			60	4.0	99.1	44.1	
WINGDAM 14	750.0	LEFT	1892			875	4.5	1,252.1	1,396.9	
				1893	REPAIRED			11.9		
				1912	REPAIRED			323.9		
WINGDAM 15	750.2	LEFT	1892			1,080	4.0	1,881.8	2,455.5	
				1912	REPAIRED			399.5		
WINGDAM 16	750.5	LEFT	1893			990	4.0	1,523.8	2,886.3	
				1912	REPAIRED			724.1		
WINGDAM 17	749.7	LEFT	1893			770	4.0	1,224.6	2,696.2	
				1910	EXTENDED	1,240		352.5	1,538.1	
				1910	REPAIRED			276.6		
WINGDAM 18	750.7	LEFT	1893			700	4.0	1,261.9	2,383.3	
				1912	REPAIRED			301.7		
WINGDAM 19	750.9	LEFT	1893			390	4.0	1,505.9	2,203.7	
WINGDAM 20	751.0	LEFT	1893			185	4.0	1,027.6	1,419.1	
				1908	SHORTENED	80				
				1908	REPAIRED			30.1		
WINGDAM 21	749.5	LEFT	1893			290	4.0	2,402.9	3,162.1	
				1910	EXTENDED	670		661.3	2,133.7	
				1910	REPAIRED			152.9	696.6	
WINGDAM 22	750.9	RIGHT	1893			304	4.0	653.8	1743.1	
				1909	REPAIRED			429.2		
				1909	EXTENDED	434		472.7	1,763.6	
WINGDAM 23	750.7	RIGHT	1893			630	4.0	1,687.7	6,345.3	
				1909	REPAIRED			662.3	864.8	

WINGDAM AND CLOSING DAM SUMMARY POOL 5

DAM TYPE & NO.	MILE	LOCATION	BUILT	MODIFIED	MOD./TYPE	LENGTH	TOP ELEV.	ROCK/CY	BRUSH/CY	LUMBER/FT
WINGDAM 23				1909	EXTENDED	770		181.7	207.1	
WINGDAM 24	750.5	RIGHT	1894			265	4.0	809.1	4,725.8	
				1909	REPAIRED			338.9	1,025.6	
				1909	EXTENDED	325		183.2	446.4	
WINGDAM 25	752.7	RIGHT	1897			620	4.0	809.1	4,725.8	
				1907	REPAIRED			578.5		
				1909	REPAIRED			309.8	664.4	
				1918	REPAIRED			83.4		
				1933	REMOVED					
WINGDAM 26	752.6	RIGHT	1897			500	4.0	1,799.9	5,287.6	
				1909	REPAIRED			437.5	1,154.3	
				1933	REMOVED					
WINGDAM 27	752.5	RIGHT	1898			480	4.0	1,413.8	4,461.4	
				1909	REPAIRED			453.9	472.6	
				1909	EXTENDED	640		504.4	1,154.3	
				1933	SHORTENED	390				
CLOSING DAM 28	752.0	RIGHT	1898			270	4.0	1,698.2	2,218.9	
				1907	REPAIRED			157.3		
WINGDAM 29	752.3	RIGHT	1898			670	4.0	2,399.8	6,747.1	
				1909	REPAIRED			675.5	931.1	
				1909	EXTENDED	903		567.6	1,466.1	
WINGDAM 30	752.1	RIGHT	1898			730	4.0	1,651.1	4,870.9	
				1909	REPAIRED			266.1	208.3	
				1909	EXTENDED	1,020		547.3	1,873.4	
WINGDAM 31	752.0	RIGHT	1898			200	4.0	877.8	922.7	
				1907	REPAIRED			73.9		
				1908	REPAIRED			177.1	146.1	
				1909	EXTENDED	490		501.9	1419.9	
WINGDAM 32	748.2	LEFT	1899			150	4.5	350.4	790.7	
WINGDAM 33	747.7	LEFT	1899			340	5.0	445.9	1,602.3	
WINGDAM 34	747.5	LEFT	1899			620	5.0	438.5	1,843.1	
WINGDAM 35	747.3	LEFT	1899			770	5.0	608.7	2,115.4	
WINGDAM 36	748.5	RIGHT	1899			720	5.0	1,285.2	4,480.5	
				1915	EXTENDED	870		338.9	965.9	
				1915	REPAIRED			181.9		
WINGDAM 37	748.3	RIGHT	1899			520	5.0	870.5	3,404.5	
				1915	EXTENDED	695		416.6	1,314.7	

WINGDAM AND CLOSING DAM SUMMARY   POOL 5

DAM TYPE & NO.	MILE	LOCATION	BUILT	MODIFIED	MOD./TYPE	LENGTH	TOP ELEV.	ROCK/CY	BRUSH/CY	LUMBER/FT
WINGDAM 38	747.9	RIGHT	1899			480	5.0	366.7	1,314.7	
				1915	EXTENDED	625		381.3	946.2	
WINGDAM 39	747.8	RIGHT	1899			375	5.0	191.4	822.3	
				1915	EXTENDED	495		210.4	818.5	
WINGDAM 40	747.1	LEFT	1899			740	5.0	457.6	1,257.8	
CLOSING DAM 41	745.7	LEFT	1899			1,200	5.5	946.4	4,061.3	
				1907	REPAIRED			96.3		
				1918	REPAIRED			298.6	326.2	
WINGDAM 42	749.1	RIGHT	1899			230	4.5	285.1	1,385.4	
				1915	REPAIRED			207.4	228.9	
				1915	EXTENDED	320		191.8	932.3	
WINGDAM 43	749.0	RIGHT	1899			500	4.5	394.5	1,522.8	
WINGDAM 44	748.8	RIGHT	1899			850	4.5	659.5	1,938.8	
WINGDAM 45	748.7	RIGHT	1899			800	5.0	1,074.2	4,551.1	
WINGDAM 46	749.4	LEFT	1899			300	4.0	561.4	1,834.8	
				1911	REPAIRED			243.5	160.1	
				1911	EXTENDED	560		413.4	1,629.4	
WINGDAM 47	743.9	RIGHT	1904			195	4.0	533.9	1,655.3	
				1922	REPAIRED			96.8	50.1	
				1922	EXTENDED	235		61.7	425.9	
				1925	EXTENDED	334		277.6	402.1	
WINGDAM 48	743.8	RIGHT	1904			260	4.0	609.4	2,347.1	
				1922	REPAIRED			122.6		
				1922	EXTENDED	320		121.6	681.8	
				1925	EXTENDED	420		175.8	399.8	
WINGDAM 49	744.4	LEFT	1905			515	4.0	868.6	1,885.3	
				1922	REPAIRED			270.8	323.8	
				1922	EXTENDED	605		305.4	1,444.3	
WINGDAM 50	744.2	LEFT	1905			415	4.0	629.8	1,982.3	
				1922	REPAIRED			295.9	169.1	
				1922	EXTENDED	490		389.4	1,485.7	
WINGDAM 51	744.0	LEFT	1905			280	4.0	531.8	1,777.5	
				1922	REPAIRED			217.9		
				1922	EXTENDED	380		269.7	1,317.1	
WINGDAM 52	745.8	LEFT	1905			140	4.0	334.1	797.9	
				1907	REPAIRED			86.8		
				1918	REPAIRED			66.1		

WINGDAM AND CLOSING DAM SUMMARY POOL 5

DAM TYPE & NO.	MILE	LOCATION	BUILT	MODIFIED	MOD./TYPE	LENGTH	TOP ELEV.	ROCK/CY	BRUSH/CY	LUMBER/FT
WINGDAM 53	745.8	LEFT	1905			153	4.0	167.9	419.7	
				1918	REPAIRED			103.4	270.1	
				1918	EXTENDED	214		102.6	497.1	
WINGDAM 54	745.7	LEFT	1905			160	4.0	224.2	593.7	
				1918	REPAIRED			82.6	210.7	
				1918	EXTENDED	235		144.9	701.7	
WINGDAM 55	745.5	LEFT	1905			255	4.0	384.1	993.7	
				1918	REPAIRED			129.1	327.2	
				1918	EXTENDED	330		127.2	714.3	
WINGDAM 56	745.5	LEFT	1905			155	4.0	266.3	600.2	
				1918	REPAIRED			100.2	318.1	
				1918	EXTENDED	260		194.1	848.1	
WINGDAM 57	745.8	RIGHT	1905			655	4.0	913.3	2,432.7	
WINGDAM 58	745.7	RIGHT	1905			670	4.0	1,270.5	3,303.9	
				1945	SHORTENED	560				
CLOSING DAM 59	745.6	RIGHT	1906			465	4.0	1,196.3	1,975.4	
WINGDAM 68	751.6	RIGHT	1908			395	4.0	938.5	2,194.7	
				1910	EXTENDED	495		255.6	1,042.9	
WINGDAM 69	751.4	RIGHT	1908			480	4.0	668.7	2,162.5	
				1910	EXTENDED	580		170.8	794.6	
WINGDAM 70	751.2	RIGHT	1908			460	4.0	1,349.7	3,558.1	
				1910	EXTENDED	560		91.5	436.3	
WINGDAM 71	751.8	RIGHT	1908			410	4.0	1,012.1	2,373.4	
				1910	EXTENDED	510		295.6	1,266.5	
WINGDAM 72	751.1	RIGHT	1908			540	4.0	1,402.6	4,178.7	
				1910	EXTENDED	640		530.3	2,676.8	
WINGDAM 73	751.1	RIGHT	1908			628	4.0	798.1	2,441.8	
				1909	REPAIRED			86.8		
				1909	EXTENDED	788		606.1	2,018.4	
WINGDAM 74	750.0	LEFT	1908			565	4.0	609.5	1,085.9	
WINGDAM 75	750.0	LEFT	1908			450	4.0	628.7	1,470.5	
WINGDAM 76	752.2	RIGHT	1909			1,000	4.0	2,118.5	7,133.8	
				1909	REPAIRED			172.4		
WINGDAM 77	752.4	RIGHT	1909			835	4.0	1,562.6	3,188.3	
WINGDAM 78	750.8	RIGHT	1909			510	4.0	831.2	2,866.2	
WINGDAM 79	750.7	RIGHT	1909			520	4.0	996.2	2,649.6	
WINGDAM 80	750.6	RIGHT	1909			580	4.0	841.6	2,165.4	

WINGDAM AND CLOSING DAM SUMMARY POOL 5

DAM TYPE & NO.	MILE	LOCATION	BUILT	MODIFIED	MOD./TYPE	LENGTH	TOP ELEV.	ROCK/CY	BRUSH/CY	LUMBER/FT
WINGDAM 81	750.5	RIGHT	1909			420	4.0	947.2	2,191.9	
WINGDAM 82	747.0	RIGHT	1910			270	4.0	822.3	2,843.5	
WINGDAM 83	746.8	RIGHT	1910			560	4.0	1,629.1	3,958.7	
WINGDAM 84	746.6	RIGHT	1910			710	4.0	1,560.6	3,776.4	
WINGDAM 85	746.4	RIGHT	1910			740	4.0	751.1	2,506.5	
WINGDAM 86	746.9	RIGHT	1910			385	4.0	1,232.4	5,148.6	
WINGDAM 87	746.6	LEFT	1910			190	4.0	547.1	1,360.7	
WINGDAM 88	746.6	LEFT	1910			145	4.0	511.5	1,503.1	
WINGDAM 89	749.3	LEFT	1910			495	4.0	819.3	3,627.7	
WINGDAM 90	749.0	LEFT	1910			435	4.0	947.5	3,518.1	
WINGDAM 91	749.3	RIGHT	1910			145	4.0	464.6	1,439.7	
WINGDAM 92	749.2	RIGHT	1910			210	4.0	424.8	986.5	
WINGDAM 93	750.0	RIGHT	1910			70	4.0	234.5	973.5	
				1911	REPAIRED			80.6		
WINGDAM 94	749.1	LEFT	1911			410	4.0	978.9	2,571.1	
WINGDAM 95	749.0	LEFT	1911			400	4.0	958.8	2,832.7	
WINGDAM 96	749.0	LEFT	1915			350	4.0	829.5	2,887.6	
WINGDAM 97	748.9	LEFT	1915			350	4.0	918.2	3,203.1	
				1923	REPAIRED			180.8	235.9	
WINGDAM 98	745.2	LEFT	1918			375	4.0	529.4	2,407.8	
WINGDAM 99	745.0	LEFT	1918			465	4.0	584.5	2,434.1	
WINGDAM 100	744.9	LEFT	1918			500	4.0	571.8	1,789.9	
WINGDAM 101	744.7	LEFT	1918			515	4.0	357.8	958.1	
WINGDAM 102	744.5	LEFT	1918			600	4.0	311.9	822.6	
WINGDAM 103	744.0	LEFT	1922			230	4.0	595.8	1,792.4	
TRAILER DAM 104	747.5	RIGHT	1923			1,720	5.0	5,556.5	15,609.1	
WINGDAM 105	747.5	RIGHT	1923			125	5.0	297.4	768.5	
WINGDAM 106	747.6	RIGHT	1923			140	5.0	601.5	2,237.5	
WINGDAM 107	747.7	RIGHT	1923			80	5.0	390.9	653.8	

SHEET 16

DAM TYPE & NO.	MILE	LOCATION	BUILT	MODIFIED	MOD./TYPE	LENGTH	TOP ELEV.	ROCK/CY	BRUSH/CY	LUMBER/FT
CLOSING DAM 1	741.2	LEFT	1879			300	4.0	1,500.1	1,152.5	
				1883	EXTENDED	400		1,051.2	666.7	
				1891	REPAIRED			590.1	1,261.8	
				1905	EXTENDED	590		632.7	1,641.4	
				1905	REPAIRED			321.4		

WINGDAM AND CLOSING DAM SUMMARY POOL 5

DAM TYPE & NO.	MILE	LOCATION	BUILT	MODIFIED	MOD./TYPE	LENGTH	TOP ELEV.	ROCK/CY	BRUSH/CY	LUMBER/FT
CLOSING DAM 1				1922	REPAIRED			38.2	193.6	
				1922	EXTENDED	690		340.3	1,420.5	
				1925	REPAIRED			648.8	2,270.8	
WINGDAM 2	740.6	LEFT	1879			620	4.0	1,191.2	1,431.1	
				1883	REPAIRED			80.1		
				1905	REPAIRED			484.9		
TRAILER DAM 3	740.4	LEFT	1879			1,400	4.0	2,012.8	3,170.1	
				1894	EXTENDED	1,500		926.2	2,672.3	
				1905	REPAIRED			757.4		
				1917	EXTENDED	1,880		716.2	2,278.2	
				1917	REPAIRED			495.2	923.3	
WINGDAM 4	740.4	RIGHT	1879			650	4.0	1,198.4	1,539.1	
				1894	REPAIRED			838.6	2,476.2	
				1905	REPAIRED			255.9		
				1912	SHORTENED	525				
				1918	REPAIRED			168.1	272.1	
				1925	EXTENDED	655		254.7	479.8	
WINGDAM 5	741.0	LEFT	1879			200	4.0	331.1	281.1	
				1883	REPAIRED			40.1		
CLOSING DAM 8	741.2	LEFT	1891			88	4.0	134.1	251.2	
				1905	REPAIRED			72.2		
WINGDAM 9	741.2	LEFT	1891			400	4.0	1,389.7	1,846.1	
WINGDAM 10	741.3	LEFT	1891			250	4.0	997.1	2,182.2	
WINGDAM 25	740.5	RIGHT	1894			610	4.0	1,168.8	5,230.2	
				1918	REPAIRED			248.7	553.1	
				1925	EXTENDED	710		255.9	509.7	
WINGDAM 26	740.6	RIGHT	1894			335	4.0	820.1	3,413.2	
				1905	REPAIRED			241.4		
				1918	REPAIRED			209.3	532.5	
				1925	EXTENDED	485		572.7	1,996.1	
WINGDAM 27	740.4	LEFT	1894			308	4.0	388.9	1,919.3	
				1917	EXTENDED	383		76.7	307.1	
WINGDAM 28	740.2	LEFT	1894			350	4.0	659.2	3,457.7	
				1917	REPAIRED			150.7	308.4	
WINGDAM 29	740.2	RIGHT	1894			870	4.0	1,189.1	4,265.6	
				1917	EXTENDED	1,070		461..5	1,523.1	
				1925	EXTENDED	1,170		363.4	595.7	

WINGDAM AND CLOSING DAM SUMMARY POOL 5

DAM TYPE & NO.	MILE	LOCATION	BUILT	MODIFIED	MOD./TYPE	LENGTH	TOP ELEV.	ROCK/CY	BRUSH/CY	LUMBER/FT
WINGDAM 30	740.0	RIGHT	1894			1,080	4.0	1,484.6	5,959.9	
				1899	REPAIRED			248.9	612.1	
				1917	REPAIRED			18.1	92.1	
				1917	EXTENDED	1,265		357.7	1,344.4	
				1925	EXTENDED	1,385		265.4	378.4	
CLOSING DAM 31	739.5	RIGHT	1899			320	5.0	548.6	834.7	
CLOSING DAM 32	739.8	RIGHT	1899			210	5.0	252.7	449.4	
WINGDAM 33	739.8	RIGHT	1899			1,200	4.5	1,847.4	3,259.5	
				1917	REPAIRED			98.1	102.1	
				1917	EXTENDED	1,410		358.4	1,157.3	
				1925	EXTENDED	1,570		273.1	714.4	
WINGDAM 34	739.6	RIGHT	1899			1,240	4.0	1,583.6	3,543.2	
				1917	EXTENDED	1,440		247.1	1,465.1	
				1925	EXTENDED	1,615		309.9	716.9	
WINGDAM 35	739.5	RIGHT	1899			1,240	4.0	1,427.7	3,173.9	
				1922	REPAIRED			41.1		
				1922	EXTENDED	1,380		285.6	1,340.7	
WINGDAM 36	739.2	RIGHT	1899			870	4.0	1,555.9	4,655.5	
				1922	REPAIRED			82.3		
				1922	EXTENDED	1,090		407.7	2,171.2	
WINGDAM 37	739.0	RIGHT	1899			1,235	4.5	1,575.1	3,795.1	
				1918	REPAIRED			277.3		
				1918	EXTENDED	1,510		441.2	2,047.3	
WINGDAM 38	739.2	LEFT	1899			570	4.0	1,212.7	3,038.1	
				1912	REPAIRED			600.8		
				1922	REPAIRED			80.8		
WINGDAM 39	739.0	LEFT	1899			870	4.0	1,278.1	3,108.3	
				1912	REPAIRED			912.7		
CLOSING DAM 40	739.0	LEFT	1899			235	5.0	127.5	330.2	
WINGDAM 44	742.0	LEFT	1904			150	4.0	159.9	172.1	
				1918	EXTENDED	350		332.6	1,684.4	
				1922	REPAIRED			78.4		
WINGDAM 45	741.9	LEFT	1904			1,220	4.0	1,245.5	2,480.4	
				1918	EXTENDED	1,320		283.1	1,627.7	
				1922	REPAIRED			84.1		
WINGDAM 46	741.7	LEFT	1904			625	4.0	1,141.2	2633.4	
				1918	REPAIRED			391.6	1,710.8	

WINGDAM AND CLOSING DAM SUMMARY POOL 5

DAM TYPE & NO.	MILE	LOCATION	BUILT	MODIFIED	MOD./TYPE	LENGTH	TOP ELEV.	ROCK/CY	BRUSH/CY	LUMBER/FT
WINGDAM 46				1922	REPAIRED			79.5		
WINGDAM 47	741.6	LEFT	1904			640	4.0	1,546.7	4,909.7	
				1918	REPAIRED			116.1	447.9	
				1922	REPAIRED			40.6	221.1	
				1922	EXTENDED	670		158.1	416.6	
WINGDAM 48	742.3	RIGHT	1904			245	4.0	461.4	1,557.9	
WINGDAM 49	742.2	RIGHT	1904			425	4.0	723.4	2,095.6	
				1918	REPAIRED			166.9		
				1925	REPAIRED			189.9	537.3	
WINGDAM 50	743.2	RIGHT	1904			520	4.0	922.4	3,285.7	
				1922	REPAIRED			63.1	50.1	
				1922	EXTENDED	585		183.6	1,152.1	
				1925	EXTENDED	685		605.1	1,965.7	
				1925	REPAIRED			238.9	208.1	
WINGDAM 51	743.0	RIGHT	1904			570	4.0	1,309.8	3,866.3	
				1918	REPAIRED			100.6	600.5	-
				1925	REPAIRED			121.2	302.6	
WINGDAM 52	742.9	LEFT	1904			80	4.0	259.6	541.1	
				1918	REPAIRED			57.7	25.1	
				1918	EXTENDED	120		149.7	694.6	
				1925	EXTENDED	220		526.1	934.2	
WINGDAM 53	742.8	LEFT	1904			150	4.0	345.7	1,095.5	
				1918	REPAIRED			38.1	92.1	
				1918	EXTENDED	260		194.4	924.5	
				1925	EXTENDED	360		265.3	811.8	
WINGDAM 54	742.7	LEFT	1904			260	4.0	377.9	778.4	
				1918	REPAIRED			92.4		
				1918	EXTENDED	435		296.3	1,149.9	
				1925	EXTENDED	535		547.6	1,558.8	
WINGDAM 55	742.8	RIGHT	1904			250	4.0	630.6	1,904.7	
				1918	REPAIRED			105.1	411.6	
				1925	REPAIRED			90.6	211.1	
WINGDAM 56	742.7	RIGHT	1904			480	4.0	825.8	2,797.7	
				1918	REPAIRED			200.9	766.4	
				1925	REPAIRED			177.4	211.1	
WINGDAM 57	743.0	LEFT	1904			75	4.0	249.9	380.1	
				1925	REPAIRED			87.9	254.2	

WINGDAM AND CLOSING DAM SUMMARY POOL 5

DAM TYPE & NO.	MILE	LOCATION	BUILT	MODIFIED	MOD./TYPE	LENGTH	TOP ELEV.	ROCK/CY	BRUSH/CY	LUMBER/FT
WINGDAM 58	741.4	LEFT	1904			750	4.0	1,871.9	6,055.1	
				1905	REPAIRED			90.7		
				1922	REPAIRED			118.5	650.4	
				1922	EXTENDED	850		387.1	1,237.9	
				1939	SHORTENED	780				
				1945	SHORTENED	670				
WINGDAM 59	741.4	LEFT	1904			700	4.0	2,266.9	3,952.5	
				1905	REPAIRED			86.1		
				1922	REPAIRED			236.9	655.5	
				1922	EXTENDED	790		319.1	1,191.2	
				1925	EXTENDED	890		966.9	2,571.6	
				1945	SHORTENED	735				
WINGDAM 60	742.4	LEFT	1904			120	2.5	158.5	451.3	
				1918	EXT/RAISED	390	4.0	326.7	1,212.1	
WINGDAM 61	743.6	RIGHT	1904			285	4.0	609.5	2,349.9	
				1922	REPAIRED			168.6		
				1922	EXTENDED	460		161.9	1,020.1	
				1925	EXTENDED	560		268.5	480.5	
WINGDAM 62	741.0	LEFT	1905			500	4.0	602.1	1,047.1	
				1922	EXTENDED	570		197.5	1,022.1	
				1925	EXTENDED	670		492.4	2,136.3	
WINGDAM 63	740.9	LEFT	1905			735	4.0	1,126.4	2,159.5	
				1922	EXTENDED	815		199.1	1,159.7	
				1925	EXTENDED	915		530.7	2,049.7	
WINGDAM 64	740.7	LEFT	1905			790	4.0	1,176.7	2,141.3	
				1922	EXTENDED	870		159.1	777.8	
				1925	EXTENDED	970		626.1	1,948.2	
WINGDAM 65	743.4	RIGHT	1907			380	4.0	692.1	1,625.6	
				1922	EXTENDED	465		129.5	716.6	
				1925	EXTENDED	565		170.9	487.1	
				1925	REPAIRED			385.1	578.1	
WINGDAM 66	743.5	RIGHT	1909			375	4.0	480.1	2,156.9	
				1922	REPAIRED			243.8	478.6	
				1922	EXTENDED	440		116.7	482.1	
				1925	EXTENDED	540		176.8	334.8	
WINGDAM 96	742.5	LEFT	1918			380	4.0	405.9	1,291.1	
				1925	EXTENDED	480		293.3	1,101.1	

WINGDAM AND CLOSING DAM SUMMARY POOL 5

DAM TYPE & NO.	MILE	LOCATION	BUILT	MODIFIED	MOD./TYPE	LENGTH	TOP ELEV.	ROCK/CY	BRUSH/CY	LUMBER/FT
WINGDAM 96				1947	SHORTENED	410				
WINGDAM 97	742.2	LEFT	1918			450	4.0	414.5	1,122.4	
WINGDAM 98	742.0	LEFT	1918			260	4.0	248.6	814.9	
WINGDAM 99	742.0	RIGHT	1918			500	4.0	1,058.9	3,759.2	
				1925	REPAIRED			473.1	1,305.6	
WINGDAM 100	739.3	LEFT	1918			250	4.0	531.1	1,645.4	
WINGDAM 101	738.9	RIGHT	1918			515	4.0	1,299/8	6,520.9	
WINGDAM 103	740.7	RIGHT	1925			250	4.5	660.5	2,971.2	
				1945	SHORTENED	180				
TRAILER DAM 104	742.6	RIGHT	1925			650	4.5	974.6	3,378.9	
WINGDAM 105	742.6	RIGHT	1925			225	4.5	863.1	3663.5	
WINGDAM 106	743.3	RIGHT	1925			625	4.5	762.7	2,640.3	
WINGDAM 107	738.7	RIGHT	1926			420	4.0	708.1	2,289.1	
WINGDAM 108	738.6	RIGHT	1926			170	4.0	423.2	1,044.2	
WINGDAM 109	741.4	RIGHT	1927			300	4.0	475.8	1,533.1	
WINGDAM 110	741.5	RIGHT	1927			420	4.0	782.7	3,139.9	
WINGDAM 111	741.6	RIGHT	1927			350	4.0	773.1	3,296.7	
WINGDAM 112	741.7	RIGHT	1927			250	4.0	540.8	1,916.9	
TRAILER DAM 113	738.7	LEFT	1927			1,800	4.0	1,843.7	6,028.6	
WINGDAM 114	738.5	LEFT	1927			260	4.0	394.2	1,698.2	
WINGDAM 115	738.9	LEFT	1927			250	4.0	415.5	1,464.5	

Appendix C

Hydraulic Analysis

Pool 5 Navigation Study
Design Memorandum
Hydraulic Appendix

Of all of the potential options identified in the main report, the modifications in Roebucks Run and the adjacent section of navigation channel are the only project features needing detailed hydraulic design discussion.

Roebucks Run conveys about 20 percent of the total Mississippi River Discharge. A closing dam across the mouth of the cut has been significantly breached and the bypassing flows are eroding the head of Island 48. Roebucks Run continues to erode. The loss of flow from the navigation channel complicates the shoaling problem in the navigation channel adjacent to Roebucks Run.

The problem at Roebucks Run can be obeserved in Plates A-1 through 3. These plates show water depths surveyed in 1991, 1992 and 1993. Reddish hues indicate water that is either marginal or too shallow for navigation. Much of the depths in the problem shoaling area are only marginally shallow for navigation.

Plates A-4 through A-6 show erosion and deposition between sucessive years. The amount of erosion and deposition in this reach is generally balanced. Observation of these plates shows a diagonal patterning of the erosion and depositional areas (particularly apparent on Plate A-6). This is due to the movement of sand waves across the shoaling areas.

Plate A-7 shows the bathymetry of Roebucks Run, the navigation channel and the shoal area. The proposed modifications to Wingdams 84 and 85, and the rock sill in Roebucks Run are also shown on this plate. The alignment of the rock sill follows a southerly alignment from its north end. This section of the sill follows shallower water created by old bank protection or a closing dam. Originally in the design phase the rock sill was expected at a lower crest elevation. The deflected alignment was used to avoid excavation before rock placement. With the higher crest elevation of the sill, the north/south alignment can be extended until it intersects the daymark closing dam. This will be **addressed in the Plan's and Specifications** phase of the project.

Dredge cuts on the shoaling area are displayed on a map of the Roebucks bend region in Plate A-8. This bend in the navigation channel is no longer functioning as a typical bend with a point bar and deep outer bend. The deep outer channel entering the bend has been captured by Roebucks Run. The navigation channel loses much of its centrifical force and flows across the wide shoaling area with little lateral variability in velocity. The large width of the channel at this bend also helps to reduce velocities across the shoaling area.

The proposed actions at Roebuck's Run are designed to reduce and hopefully eliminate the increase in discharge into Roebuck's Run and to decrease the shoaling potential in the navigation channel. The outdraft problem will be addressed only by providing a deeper, wider channel. This will make it easier for tow captains to avoid much of the water destined to enter Roebuck's Run.

The modifications at Roebuck's Run area are two fold. Wing dams 84 and 85 will be reconstructed up to an elevation of 656.0 feet. This action will help the navigation channel act more like a typical bend with higher velocities along the outer bend. A rock sill will be constructed across the entrance of Roebucks Run. This sill will have two functions. The first is to prevent a much deeper channel from forming in Roebucks Run thus taking more of the navigation channel discharge. The second function is to counteract the effect of the restored wing dams. Without the rock sill, the wing dams would force additional flow down Roebuck's Run.

The sill is also expected to cause some sediment deposition on its upstream side. Sediment depositing in this area will be prevented from passing into Roebuck's Run. This will only be a temporary reduction. When the depression has become sufficiently shallow, sediment will pass over the structure at a rate similar to existing conditions. Deposition in this area could also help shift the deep channel from hugging the Wisconsin shoreline and passing into Roebuck's Run, to a path down the navigation channel. This would also help to reduce imminent closures in this reach. There is a possibility that such deposition could cause a further reduction in flow in Roebucks Run over time. This effect is uncertain and is only mentioned as a possible outcome. If true it would be in accordance with the wishes of the Weaver Bottoms Task Force, which would prefer to see additional discharge passing through the Weaver Bottoms complex.

Two Dimensional Modeling

The TABS 2-dimensional hydraulic model of Pool 5 was used to determine appropriate sill and wing dam elevations, and wing dam lengths. The modeling allowed analysis of velocity increases over shoal areas and direction of flows. The model was also used to show the effects on discharge in other channels.

Plates A-9 and A-10 show the velocity distributions for existing and proposed conditions at a total river discharge of 30,000 cfs. Plate A-9 shows how velocities decrease as they pass over this wide shoaling bend in the river. Plate A-10 shows an increase in velocities through this bend particularly over the area of problem shoaling. Plate A-11 shows the percent increase in velocity produced by the project features. Comparison of this plate with Plates A-7 and A-8 will show that increases in channel velocity are concentrated over the shoals and traditional dredge

cuts. A similar set of plates (Plates A-12 through A-14) has been supplied for total river discharges of 80,000 cfs. The effects on velocities are very similar for the higher discharge conditions. They are slightly smaller due to the greater submergence of the proposed structures. A prediction on the effect of the higher velocities on channel depth will be discussed in the following section.

Table A-1 identifies the percent change in discharges expected from this project. The table shows that there is virtually no change in channel discharge distribution due to the project.

Kroeger Slough discharges rise by about 3 percent. Model results show that the velocity of navigation channel water passing the entrance of Kroeger Slough remains unaffected. This fact implies that sediment delivery to the entrance of Kroeger Slough remains unchanged. The slightly greater discharge into the slough could have a slight deepening effect on the slough.

Table A-1 Effect of Project on other channels.

Location	Total Mississippi River Discharge	
	30000 cfs	80000 cfs
	Percent Increase in Discharge	
Belvedere Slough	0.2	1.0
Roebucks Run	0.9	-1.3
MN-3 (Murphy's Cut)	0.5	0.7
MN-10	-0.5	-0.1
West Newton Chute	0.0	-0.1
MN-6	-0.7	-0.1
MN-7	-0.5	-0.1
Kroeger Slough	2.7	3.0
Sand Run	-1.8	-0.2
MN-14-2	-0.3	0.2
MN-14-3	-0.1	0.1
Flow not over WD 84	6.5	4.8
Flow over Wing Dam 84	-16.4	-10.5
Nav.Chan. d.s. Roebucks	-0.6	-0.1

Ability to Affect Channel Depths.

The next step is to estimate the effect on channel depth due to the concentrated flow over the shoal. For submerged wing dams, one equation for the ratio of contracted depth to uncontracted depth was given by Anderson and Davenport (1968) as

$$Yn/Y = (Qc/Q)^{0.857} * (W/Wn)^{0.857}$$

Yn = contracted channel depth
Y = uncontracted depth
Qc = flow in the contracted section
Q = total main channel flow
W = width of main channel
Wn = width of contracted channel

Table 2-A shows the Yn/Y; the increased depth factors from the above equation. Generally the channel depths are expected to become about 20 percent deeper with the project modifications in place. This would add about 2 feet of depth to the navigation channel which will hopefully reduce the amount of imminent closures.

Table 2-A Increase in Channel Depth

	Depth Increase Factor (Yn/Y)
At Q=30,000 cfs	1.21
At Q=55,000 cfs	1.19
At Q=80,000 cfs	1.17

Reasonableness of Flow Shift Due to Wing Dam Construction

Modeling the effect of wing dams using a 2 dimensional model such as RMA2 is something of an art. RMA2 is not designed to model features where there are significant vertical velocity components. Abrupt changes in grade are also undesirable. Wing dam features contain both aspects. There is also the effect of shoaling around the wing dams that can cause more uncertainty. Equations have been developed to give support to the modeling results. The report Hydraulic Evaluation of Discharge Over Rock Wing Dams on the Upper Mississippi River", which was completed by the St. Paul District for the Corps of Engineers Land Management System, evaluated flow characteristics over wing dams on Mississippi River. The report produced two equations relating to the distribution of flow over wing dams versus the flow in the entire channel.

Equation 1 $Qwd/Qmc = 0.98\ Awd/Amc - 0.019$

Equation 2 $Qwd/Qmc = 0.69\ Lwd/Wmc - 0.030$

where:

Qwd = Discharge over wing dams
Qmc = Total discharge in the main channel
Awd = Flow area over the wing dams
Amc = Flow area in the entire main channel
Lwd = Length of wing dam
Wmc = Main channel width

Table 3-A compares the results with the TABS 2 Dimensional modeling with these equations. The RMA2 model results are in good accordance with the channel flow distribution estimated using Equation 2. Equation 1 estimated a much larger discharge concentration in the portion of the channel not including the wing dams.

In the event that the wing dams are affected more than predicted (if Equation 2 is proven a better predictor), the expected 6 percent increase in discharge in the non-wingdam portion of the channel could be increased to 11 percent.

Table 3-A Comparison of RMA2 results with Equations

	Channel Flow Distribution at Wing Dam 84		
Total Mississippi Discharge in cfs	RMA2 model Qwd/Qmc	Equation 1 Qwd/Qmc	Equation 2 Qwd/Qmc
30,000	0.24	0.13	0.24
55,000	0.25	0.16	0.24
80,000	0.26	0.17	0.24

Effects on sediment movement

The project is designed to maintain existing channel flow distribution in Pool 5. Sediment loads in the various channels will not be affected by these modifications at Roebucks Run.

The wing dam renovation and the rock sill in the entrance to Roebucks Run will hopefully change the character of sediment deposition in the navigation channel. At present, the thalweg passes from the navigation channel through Roebucks Run. The flow remaining in the navigation channel has little centriphical force components causing straight line shoaling of sand waves across this wide channel. The lack of the centriphical forces prevents flow from being concentrated in a deep channel. The dredging problems occur due to localized shoaling which is often compounded by sand waves. The wave amplitude coupled with

marginal mean depths is the most significant problem involved with imminent closures.

The proposed project features are designed to increase the mean depth over the problem shoaling area. The wing dam features will provide additional lateral variability in velocity making the channel act more like a typical bend with better defined channel and point bar planform. It is hoped that this will also reduce the amplitude of the sand waves.

As previously mentioned, there will likely be a period of sediment deposition upstream of the rock sill in Roebucks Run. The depsited sand volume would be a one time sediment reduction to Belvedere Slough. This effect is only temporary and sediment will again pass through Roebucks Run at its existing rate.

The project will not significantly affect the amount of dredging in Pool 5. Dredging reduction at this location will likely be counterbalanced by increased sediment removal in downstream dredge cuts.

Island Cross Section

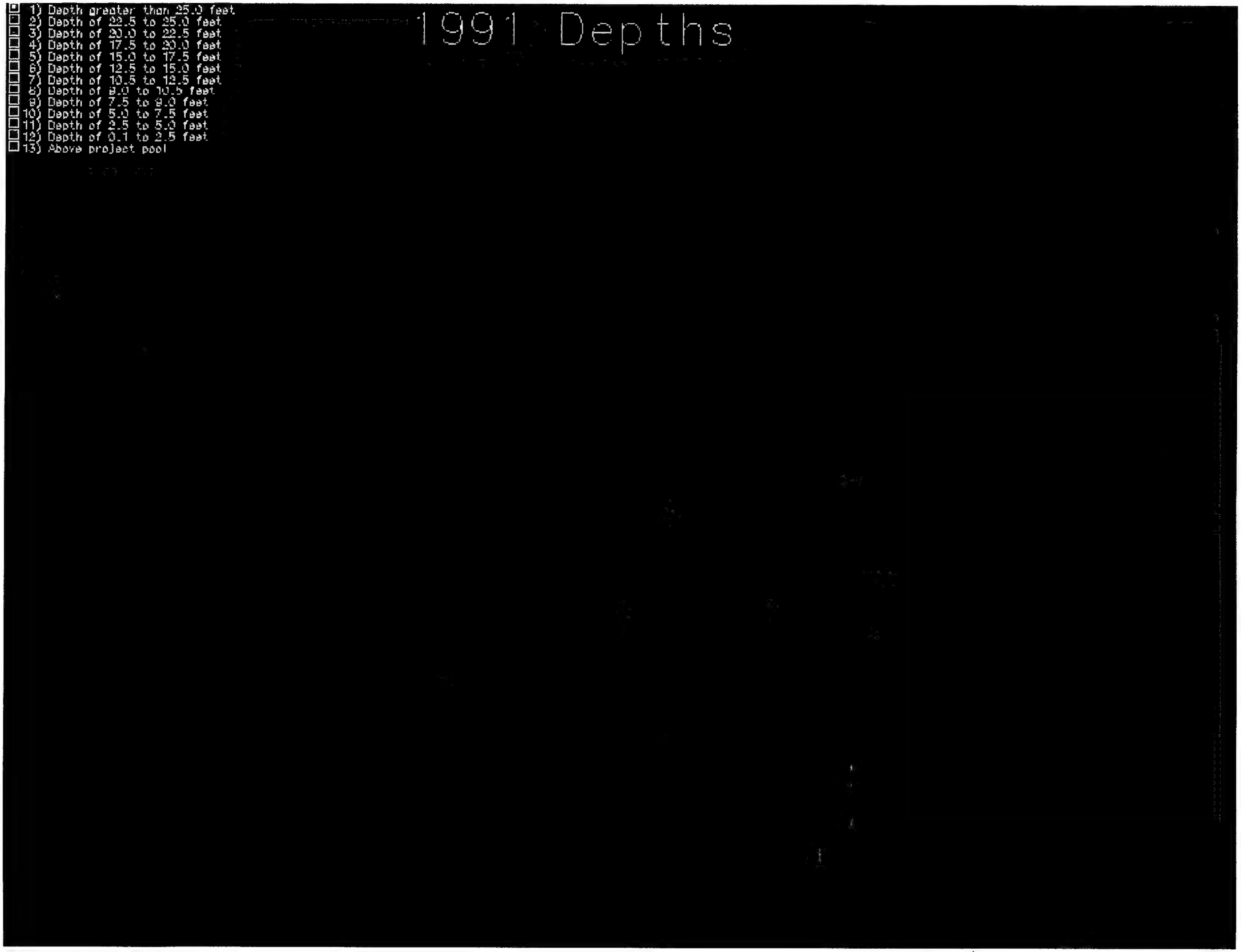
Sand dredged near Minneiska in Pool5 will be used to create islands in the lower Belvedere Slough area near the downstream end of Lost Island Lake (Plate 15). The islands are placed on existing shoals or other shallow areas. Adjacent channels are not obstructed by these future islands.

The island cross section is similar to those used in many Habitat Rehabilitation and Enhancement Projects in the Upper Mississippi River. The basic cross section design for the islands is shown on Plate 16. The base width of the island will be about 125 feet. The sand berm will be built to elevation 662.0 feet. This is the 5 year flood elevation and 2 feet above the project pool elevation of Dam 5. It is necessary that the berm be 2 feet above project pool because of the sacrificial nature of the berm. A portion of the berm is expected to erode producing a shallow beach slope. Lower elevation berms would not contain enough sand to produce the beach slope and still protect the island backbone.

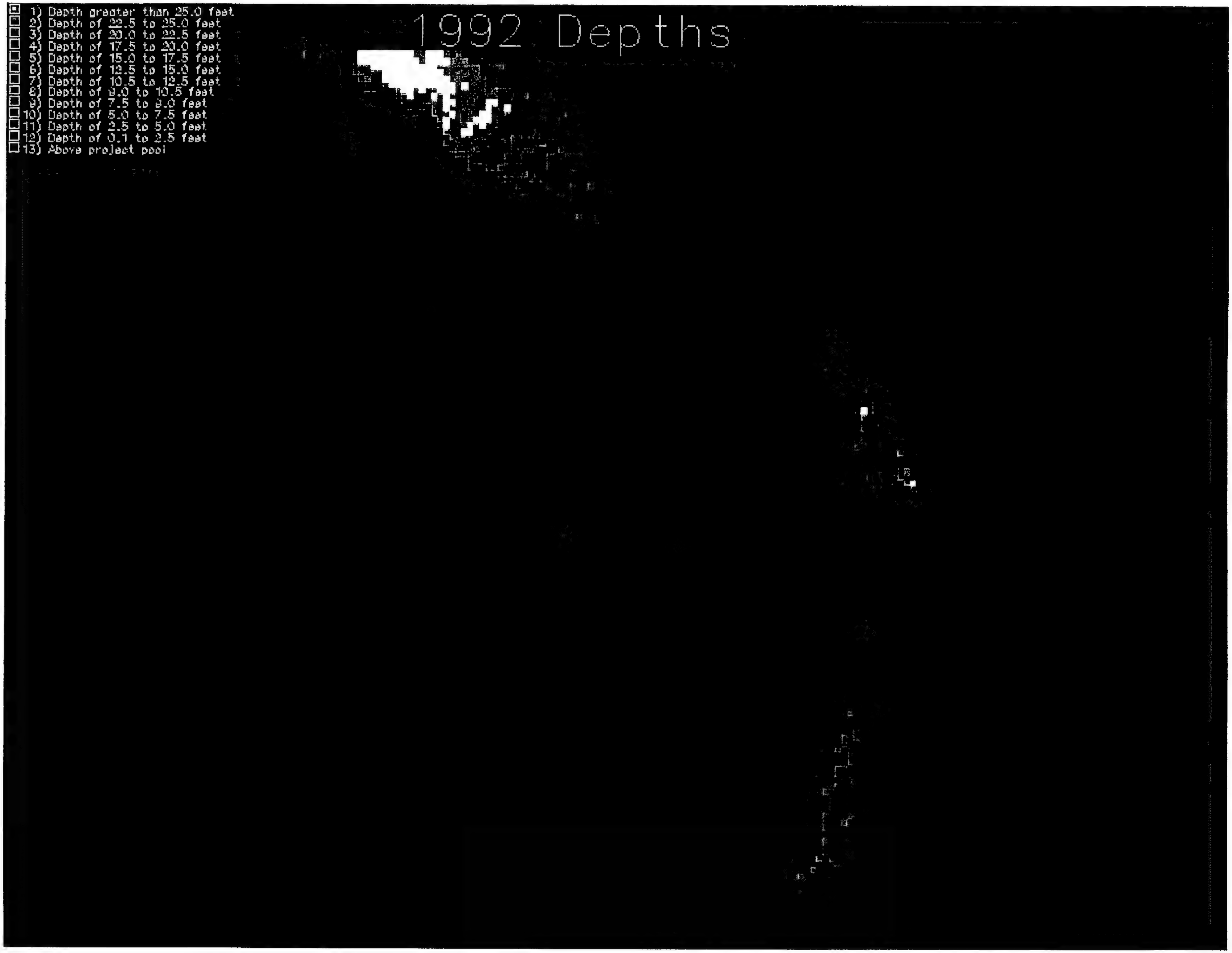
The interior portion of the island rises another 2 feet above the berm. This will provide wave breaking ability for up to the 10 year flood. The elevation of the island crest is much closer to the project pool elevation than is usual in these types of islands. This is due to the operation characteristics of the Dam 5. Water elevation at Dam 5 is does not begin to exceed the project pool elevation of 660.0 until the 5 year flood is reached.

Typically in the HREP program, groins are placed during

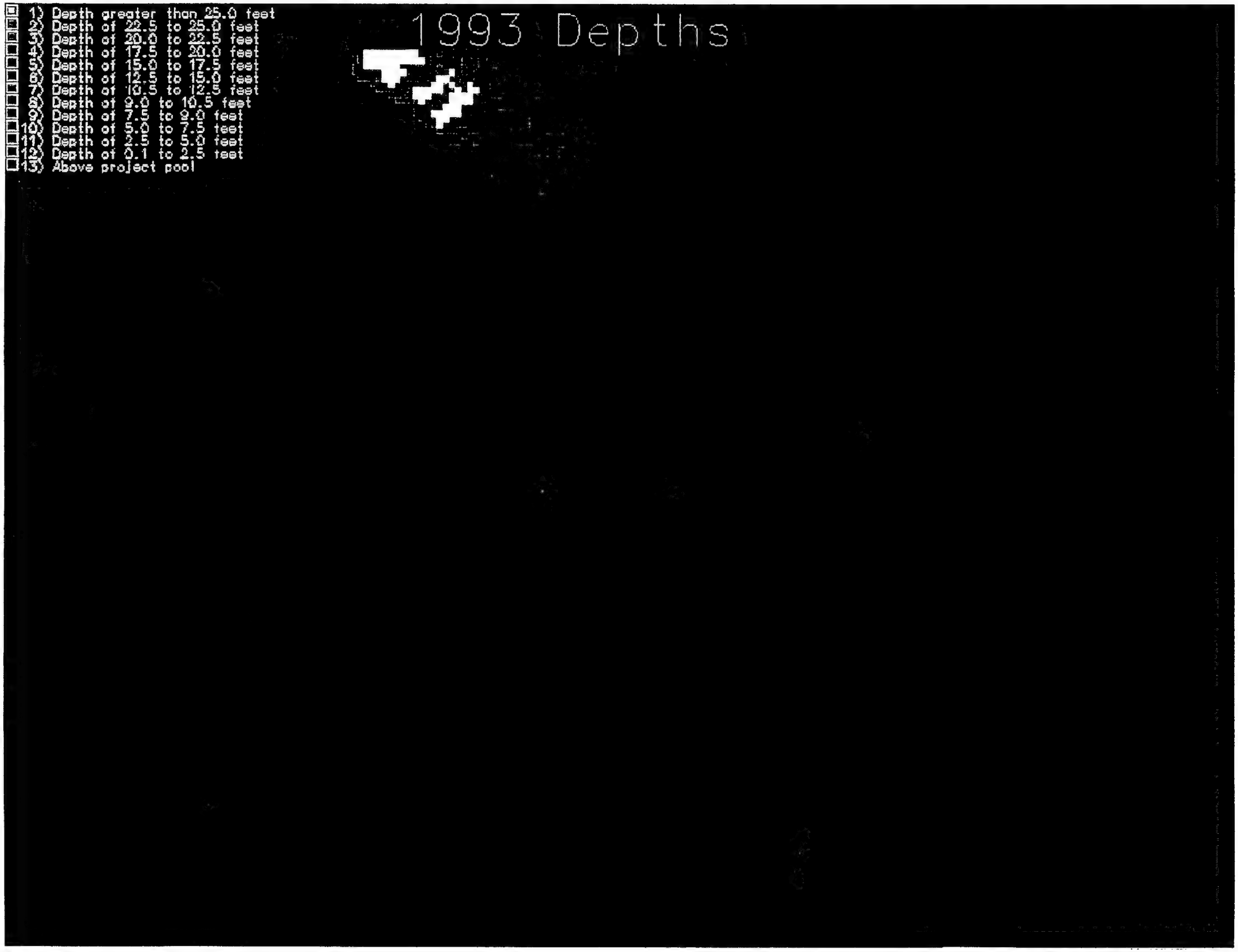
construction in all areas which may be possible erosion problem areas. This is in part due to the difficulty of funding and providing additional protection after the project is completed. Since these islands are being constructed with Channel Maintenance funding, immediate shoreline protection may not be necessary. The Corps can add erosion protection measures at any time. It may be advantageous to allow the islands to erode naturally for the first year or two after construction. Then place groins only where they are needed.



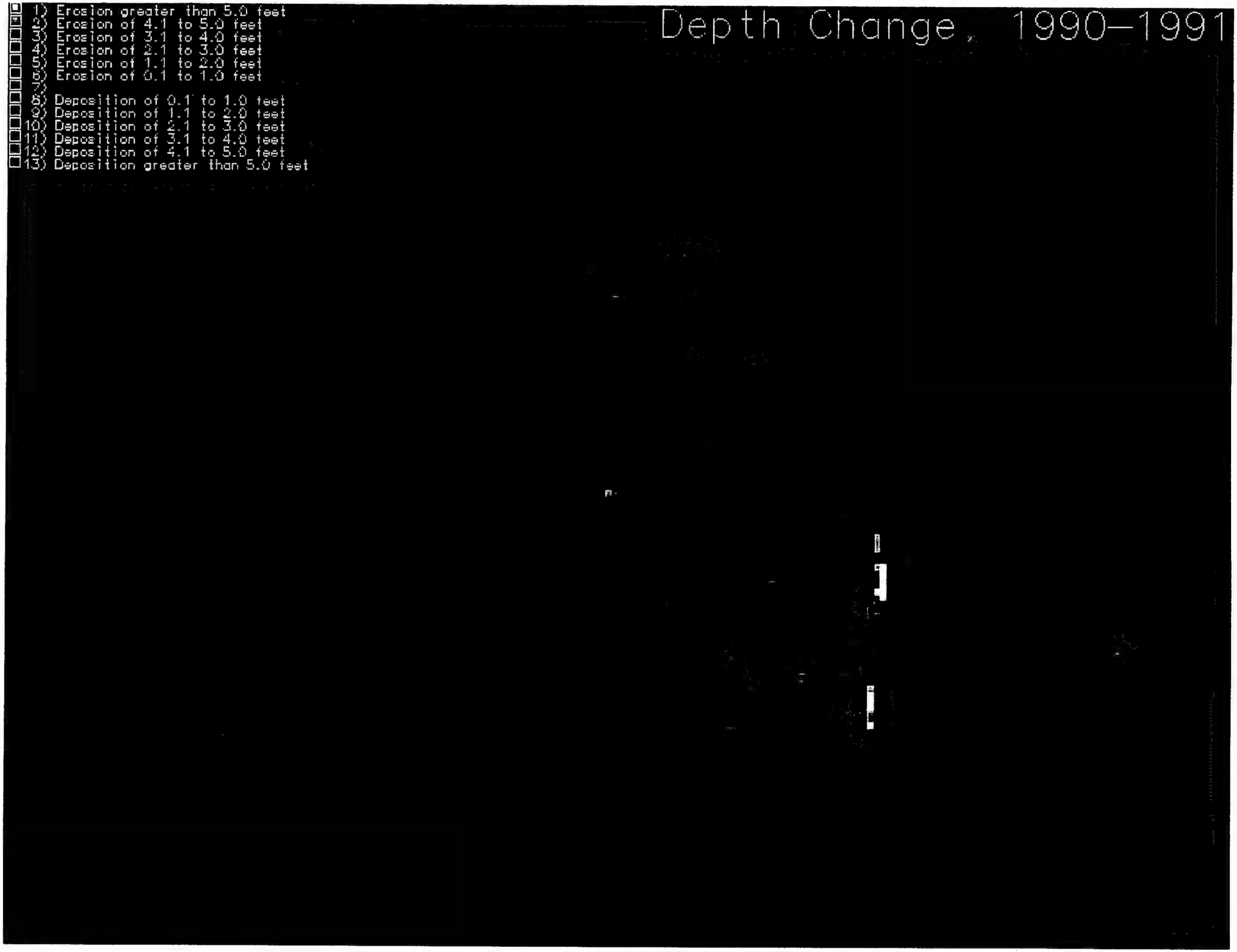
1991 Water Depths - Plate C-1



1992 Water Depths - Plate C-2



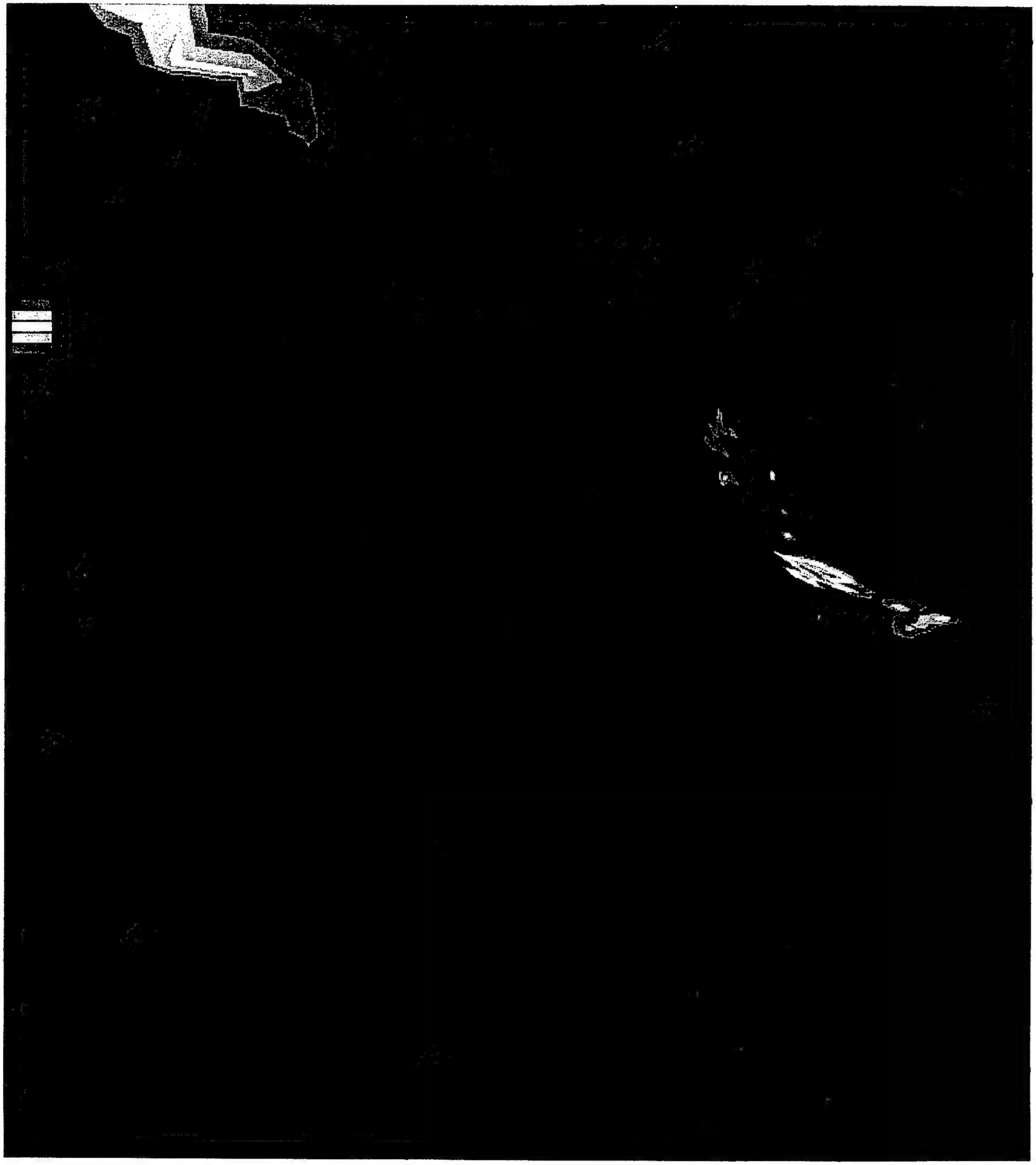
1993 Water Depths - Plate C-3



Erosion/Deposition 1990-1991 - Plate C-4

Erosion/Deposition 1991-1992 - Plate C-5

Erosion/Deposition 1992-1993 - Plate C-6

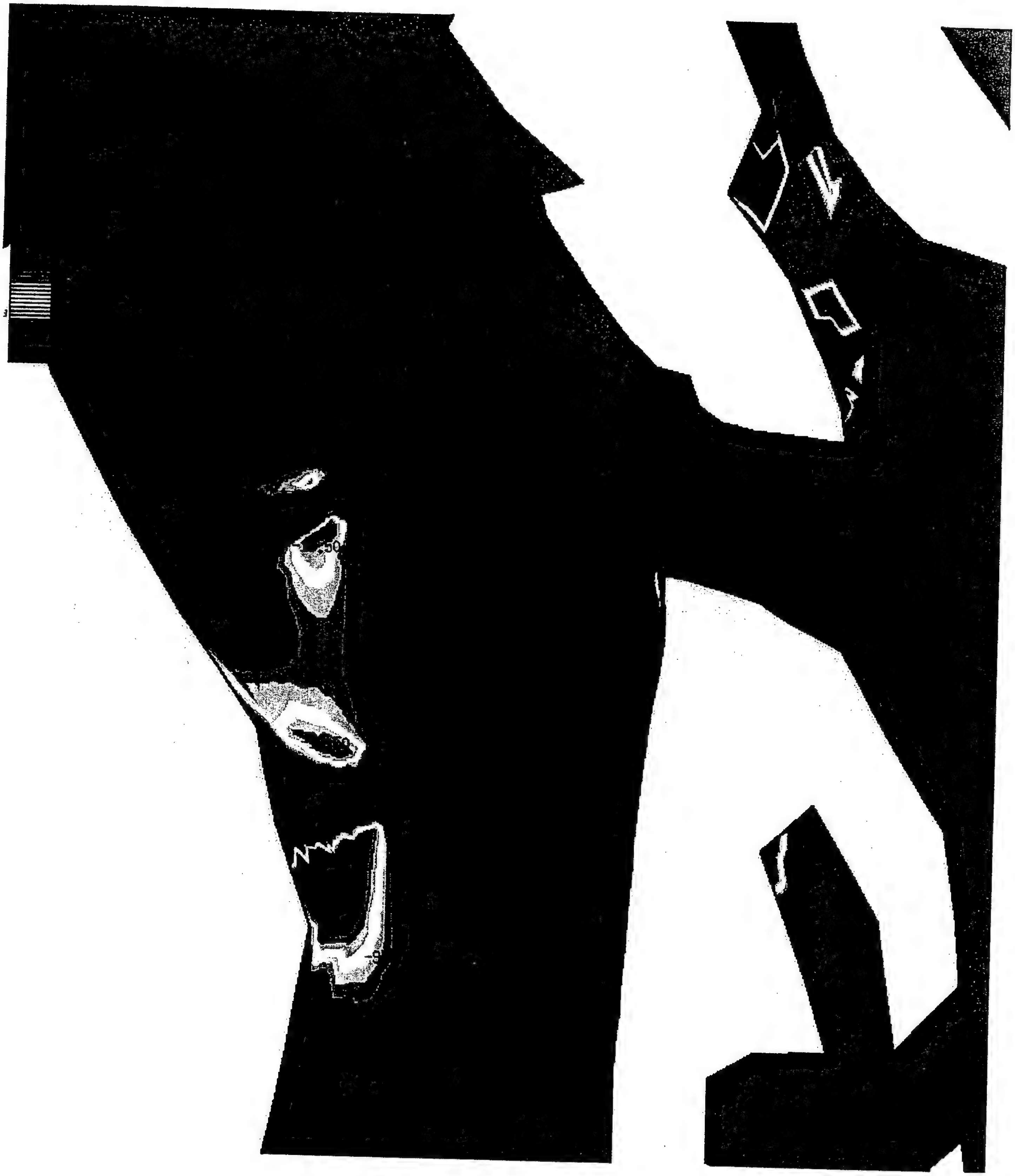


River Bathymetry at Roebucks Run -Plate C-7

Historical Dredging Locations Near Roebuck's Run - Plate C-8

Existing Condition Velocity at 30,000 cfs - Plate C-9

Proposed Condition Velocity at 30,000 cfs - Plate C-10

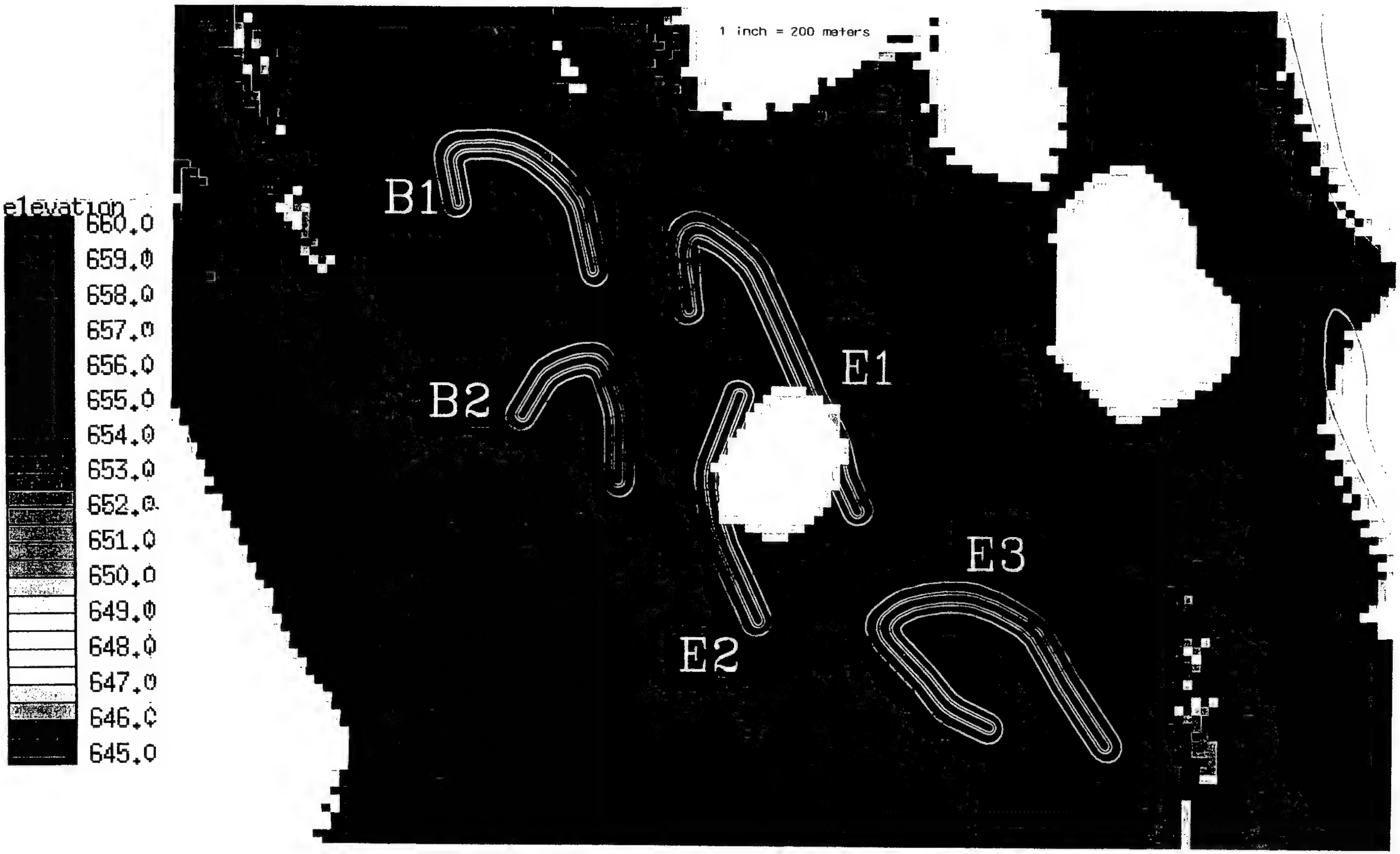


Percent Change in Velocity at 30,000 cfs -Plate C-11

Existing Condition Velocity at 80,000 cfs - Plate C-12

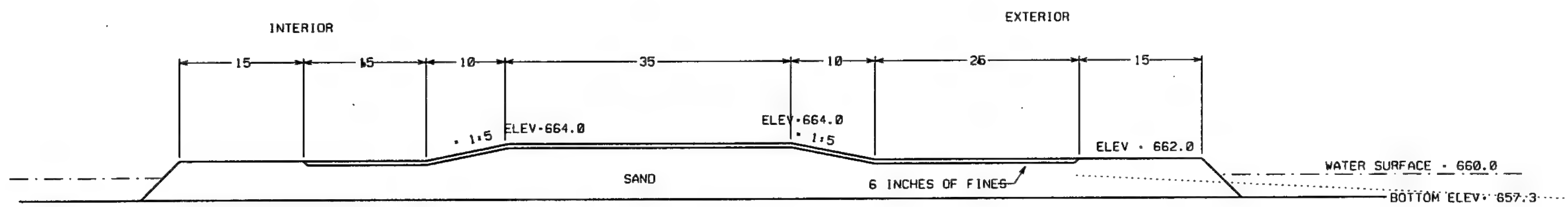
Proposed Condition Velocity at 80,000 cfs - Plate C-13

Percent Change in Velocity at 80,000 cfs -Plate C-14



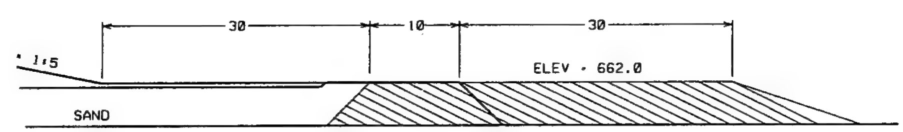
Proposed Island Layout - Plate C-15

POOL 5 CROSS SECTION FOR ISLANDS B1, B2, E1, E2, E3



93 5 YR STAGE = 652.0
10 YR STAGE = 654.0

GROIN SECTION



GROIN SPECS:

A. SIDE SLOPES SHOULD BE 1V:1.5H
B. END SLOPE SHOULD BE 1V:3H
C. GROIN SPACING - 180 FEET
D. KEY IN GROINS 10 FEET
E. GROIN CREST SHOULD EXTEND 30 FEET INTO WATER FROM THE END OF THE BERM
F. TOPWIDTH OF GROIN SHOULD BE 3 FEET

NOTE:

1) TOLERANCE = +- 0.25 FEET
2) WILLOW PLANTINGS SHOULD BE SHOWN PER PD-ER

Proposed Island Cross Section - Plate C-16

Appendix D

Cost Estimates

Lower Pool 5 Management Plan Alternates

Item Description	Unit	Quantity	Unit Price	Estimated Amount	Contingency Amount	Contingency Percent
Estimated Cost of Construction Only						
09.01. Channels						
30. Wing Dam Notching						
* Mobilize to River Mile 744 +/-	Day	2	5,000	10,000	3,500	35%
* Demobilization	Day	2	5,000	10,000	3,500	35%
Wing Dam 71 (RM 751.8 RB)	Day	1	5,000	5,000	1,750	35%
190 m3 w/disposal on downstream side.						
Wing Dams 69, 70 and 72 (RM 751.2 RB)	Day	2	5,000	10,000	3,500	35%
630 m3 w/disposal on small island remnant.						
Wing Dam 17 (RM 749.7 LB)	Day	1	6,000	6,000	2,100	35%
340 m3 w/disposal on island shoreline.						
Wing Dams 56 and 98 (RM 745.3 LB)	Day	1	5,000	5,000	1,750	35%
150 m3 w/disposal on island shoreline.						
Wing Dams 65 and 106 (RM 743.3 RB)	Day	1	5,000	5,000	1,750	35%
120 m3 w/disposal on island shoreline.						
Lower Pool Wing Dams (4, 29, 30, 33)	Day	3	5,000	15,000	5,250	35%
1035 m3 w/disposal in mound near notch.						
Total Estimated Amount (If all wing dams are done at the same time)				66,000	23,100	35%
Total Estimated Amount (All done at the same time) with Contingency					$89,000	

* Mobilization & Demobilization may be no charge if the Contractor is permitted to do the work when passing through the area.

Pool 5 Management Plan

Item Description	Unit	Quantity	Unit Price	Estimated Amount	Contingency Amount	Contingency Percent
Island 40 Protection						
Mobilization/Demobilization						
Mobilize Marine Plant	Days	2	4,000.00	8,000	2,800	35%
Demobilize Marine Plant	Days	2	4,000.00	8,000	2,800	35%
Subtotal, Mobilization/Demobilization				**16,000**	**5,600**	35%
Bank Protection						
Rockfill	M3	10,435	38.00	396,530	138,786	35%
Subtotal, Bank Protection				**396,530**	**138,786**	35%
Plans and Specifications	Job	1	30,000	**30,000**	**5,000**	17%
Construction Management	Job	1	20,000	**20,000**	**5,000**	25%
Total Estimated Cost, Island 40 Protection				**463,000**	**154,000**	33%
West Newton Chute						
Mobilization/Demobilization						
Mobilize Marine Plant	Days	2	4,000.00	8,000	2,800	35%
Demobilize Marine Plant	Days	2	4,000.00	8,000	2,800	35%
Subtotal, Mobilization/Demobilization				**16,000**	**5,600**	35%
Closing Dam						
Closing Dam Rockfill	M3	4,965	38.00	188,670	66,035	35%
Subtotal, Closing Dam				**188,670**	**66,035**	35%
Bank Protection						
Bank Protection Rockfill						
Area 1	M3	1,605	39.00	62,595	21,908	35%
Area 2	M3	770	41.00	31,570	11,050	35%
Area 3	M3	395	44.00	17,380	6,083	35%
Area 4	M3	295	47.00	13,865	4,853	35%
Daymark Tie-ins						
Wing Dam 1	M3	375	45.00	16,875	5,906	35%
Wing Dam 2	M3	475	43.00	20,425	7,149	35%
Subtotal, Bank Protection				**162,710**	**56,949**	35%
Plans and Specifications	Job	1	35,000	**35,000**	**5,000**	14%
Construction Management	Job	1	25,000	**25,000**	**5,000**	20%
Total Estimated Cost, West Newton Chute				**427,000**	**139,000**	33%
Belvidere Slough						
Mobilization/Demobilization						
Mobilize Marine Plant	Days	2	4,000.00	8,000	2,800	35%
Demobilize Marine Plant	Days	2	4,000.00	8,000	2,800	35%
Subtotal, Mobilization/Demobilization				**16,000**	**5,600**	35%
Wingdam 9 Rehab						
Rockfill	M3	450	44.00	19,800	9,900	50%

Pool 5 Management Plan

Item Description	Unit	Quantity	Unit Price	Estimated Amount	Contingency Amount	Contingency Percent
Subtotal, Wingdam 9 Rehab				19,800	9,900	50%
Plans and Specifications	Job	1	30,000	10,000	3,000	30%
Construction Management	Job	1	20,000	5,000	2,000	40%
Total Estimated Cost, Belvidere Slough				51,000	21,000	41%
Probst Lake						
Mobilization/Demobilization						
Mobilize Marine Plant	Days	2	4,000.00	8,000	2,800	35%
Demobilize Marine Plant	Days	2	4,000.00	8,000	2,800	35%
Subtotal, Mobilization/Demobilization				16,000	5,600	35%
Bank Protection						
Rockfill	M3	530	48.00	25,440	8,904	35%
Subtotal, Bank Protection				25,440	8,904	35%
Plans and Specifications	Job	1	30,000	10,000	3,000	
Construction Management	Job	1	20,000	5,000	2,000	
Total Estimated Cost, Probst Lake				56,000	20,000	
Roebuck's Run						
Mobilization/Demobilization						
Mobilize Marine Plant	Days	2	4,000.00	8,000	2,800	35%
Demobilize Marine Plant	Days	2	4,000.00	8,000	2,800	35%
Subtotal, Mobilization/Demobilization				16,000	5,600	35%
Rock Sill						
Rock Sill						
Rockfill	M3	3,045	38.00	115,710	57,855	50%
Subtotal, Rock Sill				115,710	57,855	50%
Bank Protection						
Upper Bank Rockfill	M3	1,385	39.00	54,015	18,905	35%
Lower Bank Rockfill	M3	1,590	39.00	62,010	21,704	35%
Daymark Tie-in Rockfill	M3	1,135	40.00	45,400	15,890	35%
Subtotal, Bank Protection				161,425	56,499	35%
Plans and Specifications	Job	1	35,000	35,000	5,000	14%
Construction Management	Job	1	20,000	20,000	5,000	25%
Total Estimated Cost, Roebuck's Run				348,000	130,000	37%
Wing Dam 84 and 85 Rehabilitation						
Mobilization/Demobilization						
Mobilize Marine Plant	Days	2	4,000.00	8,000	2,800	35%

Pool 5 Management Plan

Item Description	Unit	Quantity	Unit Price	Estimated Amount	Contingency Amount	Contingency Percent
Demobilize Marine Plant	Days	2	4,000.00	8,000	2,800	35%
Subtotal, Mobilization/Demobilization				**16,000**	**5,600**	35%
Wingdam 84 Rehab						
Rockfill	M3	710	42.00	29,820	14,910	50%
Wingdam 85 Rehab						
Rockfill	M3	710	42.00	29,820	10,437	35%
Subtotal, Wingdam Rehabilitation				**59,640**	**25,347**	43%
Plans and Specifications	Job	1	30,000	**30,000**	**5,000**	17%
Construction Management	Job	1	20,000	**20,000**	**5,000**	25%
Total Estimated Cost, Wing Dams 84 and 85				**126,000**	**41,000**	33%

Comparison: Mechanical to Existing Site vs Hydraulic to Build Island F

Item Description	Unit	Quantity	Unit Price	Mechanical Estimated Amount	Hydraulic Estimated Amount
MRM 743 +/-					
Year 1					
Mechanical Dredging					
Dredging	M3	15,000	7.85	117,750	
Hydraulic Dredging					
Lay out and remove pipline	Meters	2,000	14.00		28,000
Dredging	M3	15,000	6.40		96,000
Rockfill for island	M3	1,000	42.00		42,000
Subtotals, Year 1				**117,750**	**166,000**
Year 2					
Mechanical Dredging					
Dredging	M3	15,000	7.85	117,750	
Hydraulic Dredging					
Lay out and remove pipline	Meters	2,000	14.00		28,000
Dredging	M3	15,000	6.40		96,000
Subtotals, Year 2				**117,750**	**124,000**
Year 3					
Mechanical Dredging					
Dredging	M3	15,000	7.85	117,750	
Hydraulic Dredging					
Lay out and remove pipline	Meters	2,000	14.00		28,000
Dredging	M3	15,000	6.40		96,000
Fines for establishing vegetation					
Dish out island	JOB	1	15,000.00		15,000
Fill with fines	M3	15,000	15.60		234,000
Subtotals, Year 3				**117,750**	**373,000**
Year 4					
Mechanical Dredging					
Dredging	M3	15,000	7.85	117,750	
Hydraulic Dredging					
Lay out and remove pipline	Meters	2,000	14.00		28,000
Dredging	M3	15,000	6.40		96,000
Rockfill for island, Groins	M3	500	46.00		23,000
Spread Fines and Disc in	M3	3,000	3.70		11,100
Subtotals, Year 4				**117,750**	**158,100**
Year 5					
Mechanical Dredging					
Dredging	M3	15,000	7.85	117,750	
Hydraulic Dredging					
Lay out and remove pipline	Meters	2,000	14.00		28,000
Dredging	M3	15,000	6.40		96,000
Spread Fines and Disc in	M3	3,000	3.70		11,100
Subtotals, Year 5				**117,750**	**135,100**

Comparison: Mechanical to Existing Site vs Hydraulic to Build Island F

Item Description	Unit	Quantity	Unit Price	Mechanical Estimated Amount	Hydraulic Estimated Amount
Year 6					
Mechanical Dredging					
Dredging	M3	15,000	7.85	117,750	
Hydraulic Dredging					
Lay out and remove pipline	Meters	2,000	14.00		28,000
Dredging	M3	15,000	6.40		96,000
Spread Fines and Disc in	M3	3,000	3.70		11,100
Subtotals, Year 6				**117,750**	**135,100**
Year 7					
Mechanical Dredging					
Dredging	M3	15,000	7.85	117,750	
Hydraulic Dredging					
Lay out and remove pipline	Meters	2,000	14.00		28,000
Dredging	M3	15,000	6.40		96,000
Spread Fines and Disc in	M3	3,000	3.70		11,100
Subtotals, Year 7				**117,750**	**135,100**
Year 8					
Mechanical Dredging					
Dredging	M3	15,000	7.85	117,750	
Hydraulic Dredging					
Lay out and remove pipline	Meters	2,000	14.00		28,000
Dredging	M3	15,000	6.40		96,000
Rockfill for island	M3	1,000	42.00		42,000
Spread Fines and Disc in	M3	3,000	3.70		11,100
Subtotals, Year 8				**117,750**	**177,100**
Total Estimated Cost, Year 1 thru 8				**942,000**	**1,404,000**

Item	Description	Quantity	Unit	Unit Price	Estimated Amount
	Island B1				
	Hydraulic Dredging				
	Lay out/Remove Pipeline	1,200	M	13.00	15,600
	Dredge	25,000	M3	3.40	85,000
	Subtotal for Dredging				100,600
	Fines	3,700	M3	20.00	74,000
	Rockfill	650	M3	45.00	29,250
	Total Estimated Amount, Island B1				**203,850**
	Island B2				
	Hydraulic Dredging				
	Lay out/Remove Pipeline	1,200	M	13.00	15,600
	Dredge	23,000	M3	3.40	78,200
	Subtotal for Dredging				93,800
	Fines	3,000	M3	20.00	60,000
	Rockfill	600	M3	45.00	27,000
	Total Estimated Amount, Island B2				**180,800**
	Island E1				
	Hydraulic Dredging				
	Lay out/Remove Pipeline	1,200	M	13.00	15,600
	Dredge	36,000	M3	3.40	122,400
	Subtotal for Dredging				138,000
	Fines	5,600	M3	20.00	112,000
	Rockfill	950	M3	45.00	42,750
	Total Estimated Amount, Island E1				**292,750**
	Island E2				
	Hydraulic Dredging				
	Lay out/Remove Pipeline	1,200	M	13.00	15,600

Item	Description	Quantity	Unit	Unit Price	Estimated Amount
	Dredge	20,000	M3	3.40	68,000
	Subtotal for Dredging				83,600
	Fines	3,400	M3	20.00	68,000
	Rockfill	900	M3	45.00	40,500
	Total Estimated Amount, Island E2				192,100
	Island E3				
	Hydraulic Dredging				
	Lay out/Remove Pipeline	1,200	M	13.00	15,600
	Dredge	36,000	M3	3.40	122,400
	Subtotal for Dredging				138,000
	Fines	5,600	M3	20.00	112,000
	Rockfill	850	M3	45.00	38,250
	Total Estimated Amount, Island E3				288,250
	Total Estimated Amount, Island B1				203,850
	Total Estimated Amount, Island B2				180,800
	Total Estimated Amount, Island E1				292,750
	Total Estimated Amount, Island E2				192,100
	Total Estimated Amount, Island E3				288,250

For comparison only, should not be used for funding.

Appendix E

Section 404 (b) (1) Evaluation

SECTION 404(b)(1) EVALUATION

POOL 5 CHANNEL MANAGEMENT PLAN
POOL 5, UPPER MISSISSIPPI RIVER
BUFFALO COUNTY, WISCONSIN AND WINONA COUNTY, MINNESOTA

I. PROJECT DESCRIPTION

A. Location

The proposed activities would occur at various locations throughout pool 5, Upper Mississippi River. The specific locations of each activity are summarized in tables 1 and 2.

B. General Description

This evaluation addresses the impacts resulting from the placement of fill or dredged material in waters of the United States, in compliance with Section 404 of the Clean Water Act. The following actions are being recommended for implementation as part of the Pool 5 Channel Management Program: notch 14 wing dams to increase habitat diversity and productivity; stabilization of the head of Island 42 with bank protection to retard the loss of flow to West Newton Chute and further aggravation of shoaling/dredging problems; restoration of one wing dam (wing dam 9) and bank protection at the mouth of the inlet to Probst Lake to prevent enlargement; stabilization of the mouth of Roebuck's run with bank protection and a rock liner to reduce outdraft problems; restoration of wing dams 84 and 85 to reduce imminent or emergency dredging requirements at the Below West Newton dredge cut; and construction of small islands in lower pool 5 with channel maintenance material to improve habitat diversity. The proposed fill or dredge material placement activities are summarized in tables 1 and 2.

C. Authority and Purpose

The River and Harbor Act of July 3, 1930, authorized a 9-foot channel navigation project on the Upper Mississippi River. The proposed modification/restoration of control structures and island creation would be conducted under this authority. The purpose of this channel control structure project are to reduce or control dredging requirements, improve navigation safety, reduce adverse environmental effects of existing channel control structures, and restore natural river processes and functions as much as possible.

Table 1. Summary of wing dam notches for Pool 5 CMP.

Project Feature	Location	Sand & rock (m^3)	Notch width (meters)	Material Use
Wing dam 71 notch	RM 751.8 right bank	190	5	rock mound
Wing dam 69 notch	RM 751.4 right bank	630	30	rock mound
Wing dam 70 notch	RM 751.2 right bank	520	30	stabilize bank
Wing dam 72 notch	RM 751.1 right bank	575	30	rock mound
Wing dam 17 notch	RM 749.7 left bank	340	17	stabilize bank
Wing dam 83 notch	RM 746.8 right bank	200	3	stabilize bank
Wing dam 56 notch	RM 745.5 left bank	100	3	stabilize bank
Wing dam 98 notch	RM 745.2 left bank	50	3	stabilize bank
Wing dam 65 notch	RM 743.4 right bank	70	3	stabilize bank
Wing dam 106 notch	RM 743.3 right bank	50	3	stabilize bank
Wing dam 4 notch	RM 740.4 right bank	280	10	rock mound
Wing dam 29 notch	RM 740.2 right bank	215	10	rock mound
Wing dam 30 notch	RM 740.0 right bank	300	10	rock mound
Wing dam 33 notch	RM 739.8 right bank	240	10	rock mound

Table 2. Structural modifications and island creation in pool 5.

Project Feature	Location	Sand (m^3)	Rock (m^3)	Fines (m^3)
Island 42 bank protection	RM 750.0 right bank		770	
Belvidere - wing dam 8 rehab	RM 748.0 left bank		450	
Probst - bank protection	RM 748.0 left bank		530	
Roebucks - bank protection	RM 746.6 left bank		1,720	
Roebucks-daymark tie back	RM 746.6 left bank		1,135	
Roebucks - wing dam 84 rehab	RM 746.6 right bank		710	
Roebucks - wing dam 85 rehab	RM 746.4 right bank		710	
Roebucks - liner/sill	RM 746.6 left bank		3,045	
Island B1	RM 743.3 left bank	25,000	650	3,700
Island B2	RM 743.3 left bank	23,000	600	3,000
Island E1	RM 743.2 left bank	36,000	950	5,600
Island E2	RM 743.2 left bank	20,000	900	3,400
Island E3	RM 743.2 left bank	36,000	850	6,000
Total		140,000	16,783	21,700

D. General Description of Dredged or Fill Material

1. General Characteristics of Material

Material removed from the wing dams to create notches would likely be mostly rock, with some sand and remanent willows that were used in the initial construction. All of the islands proposed for construction would be constructed of clean main channel sand, protected with rock groins or riprap where required, and capped with fines dredged near the island site. The rock use for island protection and wing dam modification would be the standard quarry run rock.

2. Quantity of Material

The quantity of material for each is summarized in tables 1 and 2. Construction of the proposed islands may require some limited dredging to provide equipment access. This dredged material would be used in the construction of the islands. Notching of the wing dams or other structural modifications would probably occur during high water, limiting the need for access dredging. However, some

limited access dredging of sand material may be necessary. This material would be used as a base for bank stabilization or rock mound creation. Any additional material would be hauled by barges to one of the existing dredged material containment sites in pool 5.

3. Source of Material

The sand material required for the proposed islands would be dredged hydraulically from the main channel. Fine material to cap the island complex would be dredged from near the proposed island sites. The specific location for the borrow areas will be determined by an interagency on-site team. Rock would be obtained from any of several active quarries located in the vicinity.

E. Description of the Proposed Discharge Sites

1. Location

The locations of the project features are summarized in table 1.

2. Size

Around 80 meters of shoreline would be protected with rock riprap at the entrance to Probst Lake. Around 130 meters of the head of Island 42 would be stabilized with rock.

The rehabilitation of wing dam 9 at the head of Belvidere Slough would impact around 0.15 hectares of existing wing dam habitat. Around 0.11 and 0.08 hectares of existing wing dam habitat would be impacted by the modifications of wing dams 84 and 85, respectively.

The rock sill at Roebucks Run would cover around 0.19 hectares of existing sand substrate. At Roebucks Run around 80 meters of shoreline would be protected with rock riprap. In addition the rehabilitation of the wing dam and daymark at Roebucks Run would impact around 0.08 hectares of existing rock habitat.

The size of the five islands to be built in lower pool 5 are summarized in table 3. They would have a top width of 11 meters, a maximum elevation above sea level of 203.8 meters(1.2 meters above low control pool), and a 1 vertical on 5 horizontal side slopes.

Table 3. Island size.

Island	Foot-print (hectares)
E1	2
E2	1.4
E3	2.1
B1	1.4
B2	1.2

3. Type of Site

The shoreline areas proposed for riprapping are cut bank areas. The wing dam notching and rehabilitation sites are predominately rock habitat, that have either been buried by sand or have degraded since initial construction. The islands are located in areas with water depths less than 1 meter with a silty substrate. The locations were chosen because they were sufficiently shallow and are situated such that construction of islands would promote and protect adjacent vegetation beds.

4. Types of Habitat

The wing dam notching and rehabilitation and the bank protection sites are either main channel border habitat or mouths of secondary channel habitat.

The proposed island construction would be done in the relatively shallow aquatic habitat of a open backwater lake area.

F. Description of Disposal Method

All sand for construction of the proposed islands would be dredged and placed hydraulically. Fine material would be dredged and placed mechanically or, if dredged hydraulically, would be placed in bermed areas on the newly created island sand base. Rock for the island groins and proposed structure modifications would be obtained from existing local quarries and placed mechanically.

II. FACTUAL DETERMINATIONS

A. Physical Substrate Determinations

1. Substrate Elevation and Slope

Wing dams 83, 84, 9, and the tie-back of the day marker to the shore would have a top-width of 2.4 meters, top elevations of 200.0 meters above mean sea level, and side slopes of 1 vertical on 2 horizontal.

The islands are located in areas of water depths less one meter. The islands would have a maximum elevation of 203.8 meters above mean sea level(1.2 meters above low control pool). The islands would have a 1 vertical on 5 horizontal side slopes, with a flat 9 to 15 meter berm along the shorelines, 0.6 meters above low control pool.

2. Sediment Type

The substrate at the wing dams proposed for notching or modifications consists of predominately rock, with some sand. The substrates in the areas proposed for stabilization consists of sand and silty sand. The rock sill at Roebucks would cover a predominately coarse sand substrate.

The islands would be located in an area with a substrate consisting of silts overlaying sand. Material dredged for equipment access would consist primarily of silt or silty sand.

3. Dredged/Fill Material Movement

The wing dams are being notched to cause a scour hole to develop and/or to deepen secondary channels. Sand material that is eroded at these sites will become a relatively small portion of the bed load moving in the main channel border. Some of the rock removed from the wing dams would be used to stabilize existing shorelines.

The proposed rock work at Island 42, Belvidere Slough and Roebucks Run are intended to stabilize shorelines and the river bottom.

Once construction is complete, fill material movement at the island sites should be minimal. Island shoreline areas prone to erosive forces such as those bordering flow areas and those affected by wind and wave action would be protected with rock groins. Sacrificial flat berms have been incorporated into the designs of the island. These berms will be reshaped by natural forces to a stable slope, both under and above water. The areas interior of the sacrificial berm would be top soiled and once vegetated should be fairly stable.

4. Physical Effects on Benthos

Any organisms in the fill areas for the proposed structural modifications and island creation would be covered and eliminated. The newly created rock substrate at the bank stabilization sites would quickly colonize with benthos.

Mussel surveys were conducted in 1998 in the areas proposed for construction activities, except the proposed island sites or the unidentified borrow sites for topsoil. A mussel survey was completed at a potential island location, with similar habitat characteristics and located close to the proposed islands sites. Only commonly occurring species were encountered in the surveys. No State or Federally-listed species were collected. Approximately 8.1 hectares of benthic habitat would be covered and eliminated by the construction of the islands. However, the substrate and improved water quality created by the islands would offset much of this loss. The substrates of the islands would consist of areas of sand and rock riprap and should provide an excellent substrate for benthic organisms.

Around 2.2 hectares of benthic habitat would be dredged to obtain top soil material for the islands. This area should quickly re-colonize upon project completion.

5. Actions Taken to Minimize Impacts

No special actions would be taken to minimize adverse impacts on the substrate.

B. Water Circulation, Fluctuation, and Salinity Determination

1. Water

a. Salinity

Not applicable.

b. Water Chemistry

The use of clean fill materials should preclude any significant impacts on water chemistry.

c. Clarity

Some minor, short-term decreases in water clarity are expected from the proposed fill activities. Hydraulic dredging and placement of sand materials for island construction would create local turbidity plumes and increased suspended solids. Dredging and placement of fines would also be expected to result in localized decreases in

water clarity. However, the long-term effect from fill placement should be an improvement in water clarity.

d. Color

The proposed fill activities should have no effect on water color.

e. Odor

The proposed fill activities should have no effect on water odor.

f. Taste

The proposed fill activities should have no effect on water taste.

g. Dissolved Oxygen Levels

The proposed fill activities should have no effect on dissolved oxygen levels.

h. Nutrients

The proposed fill activities should have no effect on nutrient levels in the water.

I. Eutrophication

The proposed fill activities should have only minor effects on the level or rate of eutrophication of the water.

j. Temperature

The proposed fill activities should have no effect on water temperatures.

2. Current Patterns and Circulation

a. Current Velocity and Patterns

Notching wing dams 69, 70, and 72 in the secondary channel in front of Lanes Island will increase flow through this secondary channel. The remaining wing dam notching sites will not cause significant changes in flow patterns in the main channel border, but only localized increases in flow and current velocity in and adjacent the notch. The proposed modifications of wing dams 84 and 85 and the actions proposed at the mouth of Roebucks Run would modify current patterns. A slight increase in current velocities would occur in the main channel habitat. A 10 to 15 percent decrease in current velocities would occur in the main channel border habitat, where the wing dams are located. Partial stabilization of the large

secondary channels at West Newton Chute, Belvidere Slough and Roebucks Run would retard future increases in flow.

The islands would change the local flow patterns. Current velocities from advective and wind-induced wave action would be reduced within the shadow zones of the new islands.

b. Stratification

The proposed fill activities should have no effect on stratification conditions.

c. Hydrologic Regime

The proposed project would not significantly alter the existing hydrologic regime within pool 5. Partial stabilization of the large secondary channels at West Newton Chute, Belvidere Slough and Roebucks Run would slightly retard future increases in connectivity with the associated backwaters. Construction of the proposed islands would reduce the effects of wind and wave action in a localized area.

3. Normal Water Level Fluctuations

The proposed fill activities would have no effect on normal water level fluctuations. No measurable floodplain impacts would occur with any of the projects features, individually or cumulatively.

4. Salinity Gradient

Not applicable.

5. Actions Taken to Minimize Impacts

No special actions would be taken to minimize the effects of the proposed project on current patterns or flow.

C. Suspended Particulate/Turbidity Determination

1. Expected Changes in Suspended Particulates and Turbidity Levels in the Vicinity of the Disposal Site

Minor increases in suspended particulates would occur from placement of rock at the proposed rehabilitation or modification of structures.

Hydraulic dredging and placement of sand for construction of the proposed islands would cause localized turbidity plumes. However,

the sand material proposed for use is relatively coarse, and suspended particles would be expected to dissipate rapidly. Mechanical dredging and placement of fines or hydraulic dredging and placement in bermed areas on the islands would also be expected to cause some localized turbidity. However, the majority of the fines proposed for use in this project would be placed above the normal pool elevation and would not be subject to resuspension in the aquatic system.

After project completion, conditions would quickly return to normal. The use of rock groins or riprap in high energy areas on the islands would eliminate the resuspension of material in those areas. Areas above normal pool elevation would be planted with willows and native grasses.

2. Effects on Chemical and Physical Properties of the Water Column

No effects are expected on dissolved oxygen, toxic metals, organisms, pathogens, or the aesthetics of the water column after the project is in place.

3. Effects on Biota

After island construction, reduced flows along with less resuspension of bottom sediments due to wind and wave action would result in improved water clarity and the establishment of additional aquatic vegetation benefiting the fish and waterfowl that use this area.

4. Actions Taken to Minimize Impacts

Island construction would take place during periods of low to normal water levels. Dredging and placement of fine materials would be done mechanically or, if done hydraulically, would be placed into bermed containment sites on the islands to minimize suspension of particulates in the water column.

D. Contaminant Determinations

Only relatively old sediment quality data are available for either the main channel or backwater sediments. Results of the analysis are shown in Table 3. Contaminants of concern were found to be comparable to those of other main channel sediments or fine sediments of backwaters of the Upper Mississippi River. Only trace amounts of pesticides or PCBs have been found. Past sediment analysis suggests that serious water quality problems would not be anticipated with the proposed projects in pool 5. Further sediment analysis will be conducted once the borrow sites for the topsoil material for the islands have been identified.

Rock riprap would be obtained from existing local quarries. These areas do not have a history of contamination, and use of this material should not introduce any contaminants into the aquatic ecosystem.

E. Aquatic Ecosystem and Organism Determination

1. Effects on Plankton

During construction, increases in turbidity and suspended solids near the dredged material placement/fill activities would have a localized suppressing effect on phytoplankton productivity. However, these local effects are not considered significant. The plankton populations would recover quickly once construction activities ceased.

2. Effects on Benthos

The proposed structural modifications would have either a neutral or slightly positive long-term affect on benthos productivity.

The proposed islands would cover and eliminate the benthic organisms occupying approximately 8.1 hectares of lower pool 5 substrate. An additional 2.2 hectares of lower pool 5 bottom and benthic organisms would be dredged to obtain fine topsoil and increase deepwater habitat. Benthic organisms would quickly be replaced in the dredged channel. The sand and rock substrates created by the islands would quickly be colonized. The sand and rock substrates created would provide a more stable and diverse habitat than currently exists.

Reduced flows along with less resuspension of bottom sediments due to wind and wave action would result in improved water clarity and the establishment of additional aquatic vegetation benefiting the fish and waterfowl that use this area.

3. Effects on Nekton

During construction, increases in turbidity and suspended solids near the dredge, fill, and effluent return areas would have a localized suppressing effect on nekton productivity. However, these effects would be local and are not considered significant. The nekton populations would recover quickly once construction activities ceased.

Table 3. Sediment Quality - Samples from 1974 to 1989.

Parameter	Units	Backwater mean +2SD	Sommerfield Minimum	Sommerfield Maximum	Mt Vernon Minimum	Mt Vernon Maximum	Backwater Minimum	Backwater Maximum
Total Organic Carbon	%		0.03	0.09				
Moisture Content	%		0.9	0.9				
Volatile Solids	%		0.6	0.8				
Sand (>200 mm)	%		96	100	92	99	13	28
Silts & clays (<200 mm)	%		0	4	1	8	72	87
Arsenic	ug/g	8.5	0	2	0	0	0	13
Cadmium	ug/g	4.2	0	0	0	1	0	2
Chromium	ug/g	37	0	33	0	0	19	34
Copper	ug/g	27	0	7	0	0	11	14
Cyanide	ug/g	<2	<2	<2	<2	<2	<2	<2
Lead	ug/g	29	0	2	0	0	14	20
Manganese	ug/g	943	100	480	100	480		
Mercury	ug/g	0.32	0	0.4	0	0.8	0	0.05
Nickel	ug/g	45	0	26	0	20	18	25
Ammonia	ug/g	200	0.9	0.9				
Zinc	ug/g	112	0	75	0	10	48	79
a-BHC	ug/kg		ND	ND	ND	ND	ND	ND
b-BHC	ug/kg		ND	ND	ND	ND	ND	ND
g-BHC	ug/kg		ND	ND	ND	ND	ND	ND
d-BHC	ug/kg		ND	ND	ND	ND	ND	ND
Chlordane	ug/kg		ND	ND	ND	ND	ND	ND
4,4'-DDD	ug/kg		ND	ND	ND	ND	ND	ND
4,4'-DDE	ug/kg		ND	10	ND	ND	ND	ND
4,4'-DDT	ug/kg		ND	ND	ND	ND	ND	ND
Dieldrin	ug/kg		ND	ND	ND	ND	ND	ND
Endrin	ug/kg		ND	ND	ND	ND	ND	ND
Heptachlor	ug/kg		ND	ND	ND	ND	ND	ND
PCBs Total-1016	ug/kg		0	0	0	6	0	14

4. Effects on Aquatic Food Web

The burial of existing benthos and localized impacts on plankton could cause a temporary, minor impact on the local food web. Benthos should quickly colonize the project features and no long term adverse impact on the aquatic food web is anticipated. The proposed islands could improve the total productivity of the lower pool 5 area. A small portion of the lower pool 5 area would gain protection from wind and wave action, water clarity would improve, and aquatic plants would be enhanced.

5. Effects on Special Aquatic Sites

Islands B1 and B2 are located in a designated Closed Area (no hunting during the fall waterfowl hunting season) of the Upper Mississippi River Wildlife and Fish Refuge. Some restrictions on construction during the waterfowl hunting season could be imposed by the U.S. Fish and Wildlife Service. All the islands were designed to improve habitat conditions in this area for wildlife and fish and are compatible with Refuge goals and objectives.

6. Threatened and Endangered Species

No known Federally- or State-listed threatened or endangered species would be affected by the project.

7. Other Wildlife

The fill activities would not result in the significant loss of aquatic or terrestrial habitat. The general diversity and productivity of the affected areas would increase.

8. Actions Taken to Minimize Impacts

No special actions are required.

F. Proposed Disposal Site Determinations

1. Mixing Zone Determination

A localized turbidity plume is anticipated during island construction. However, the sand fill material proposed for use would be sufficiently coarse and relatively clean so that very little exposed material could be suspended in the water column. Localized turbidity plumes are also anticipated during dredging and placement of the fine material proposed for use as topsoil in capping the proposed islands. Mechanical dredging of fines or hydraulic dredging and placement of fines into a bermed containment

area on the islands would minimize the amount of material susceptible to suspension in the water column. Suspended solids should return to near background levels 200 to 300 meters downstream of the islands.

2. Determination of Compliance with Applicable Water Quality Standards

It is not anticipated that the proposed project would violate Minnesota's or Wisconsin's water quality standards for toxicity. Minnesota's standard of 30 milligrams per liter for total suspended solids would most likely be exceeded in the turbidity plumes generated through hydraulic dredging and placement of sand and fine material for island construction. It is anticipated that within a relatively short distance from the discharge point, suspended solids would return to near normal conditions.

Rock riprap would be obtained from approved pits and quarries in the project area. This area does not have a history of contamination, which should insure that State water quality standards would not be violated during placement of this material.

3. Potential Effects on Human Use Characteristics

a. Municipal and Private Water Supply

No municipal or private wells would be impacted by the proposed project.

b. Recreational and Commercial Fisheries

The wing dam notching and island creation are being done to increase habitat diversity and fish and wildlife values. As such, recreational fishing could improve slightly. The project may also result in a slight improvement to the commercial fishery.

c. Water Related Recreation and Aesthetics

The aesthetics of the area would be reduced during construction because of the presence and operation of dredging and other construction equipment. Minimum water depths of 1.2 meters would be maintained over the wing dams that are rehabiltated to avoid potential impacts on recreational boaters.

After completion of the islands, wind and wave action would be reduced and the area would see increased usage by waterfowl and other wildlife benefiting water-related recreation and the aesthetic values of the area.

d. Cultural Resources

No archaeological sites or shipwrecks are known for the West Newton Chute area, but there is a concentration of five archaeological sites on the Minnesota shore just to the west of the head of West Newton Chute (21 WB 51, 52, 58, 59, and 60). The stabilization work will have no effect on these sites.

Three shipwrecks are known for the Belvidere Slough area. The Belvidere Slough head is upstream of these and any work on bank stabilization will not affect any possible remains of these wrecks. The large mound site (47 BF 65) at Indian Point, just inland of the head of the slough will not be affected by any work on the bank or wing dam. Wing dam 9 was built in 1891 as part of the 4½ -foot channel project. Belvidere Slough was closed off with closing dams 1 and 2, just downstream of wing dam 9, in 1880 in the earliest stages of the 4½ foot channel project. Probst Lake and channel are evidently post-inundation features of the landscape; the 1915 navigation map shows only Belvidere Island in that location. Shoreline survey showed no sites in the area, and thus the work will have no effect on any historic properties.

Roebuck's Run is also a relatively recent (post-inundation) channel; the channel now crosses what was in 1915 the center or "waist" of Belvidere Island. No historic properties will be affected by any channel and bank work.

The locations of the proposed islands are on lands now almost entirely inundated. Before inundation, the landforms were Sommerfield Island, lying between Buffalo City and the Weavers Bottom, and various low-lying islands and bottomlands downstream of Sommerfield Island. Survey of the lands remaining above water has revealed no archaeological sites or historic properties.

The wing dams that will be affected by the project plans are historic structures, some of them over a century old. They are associated with significant movements in the history of navigation on the Mississippi River, the 4 ½- and 6-foot channel projects built by the Corps of Engineers. The wing dam system overall and in particular as historic structures have not yet been evaluated for their eligibility for inclusion in the National Register of Historic Places. However the structures have been inundated by the 9-foot channel project, and are not visible. Notching and/or fortifying the wing dams will not affect their interpretive potential.

G. Determination of Cumulative Effects on the Aquatic Ecosystem

The secondary channels that are being modified to retard future expansions (West Newton Chute, Belvidere Slough, and Roebucks Run) presently are highly connected to the main river, carrying 20 to 25 percent of the total river flow. Maintaining these flows will mean that backwaters associated with these secondary channels will continue to experience high rates of sedimentation, with resulting changes in land forms. This could be viewed as bad by some people who see their favorite backwater lake fill and recreational boat naviagtion become more difficult. Other people, who feel the formation of deltas and braided channel habitat is a natural process, may view this sedimentation as good.

The proposed islands would result in the establishment of additional aquatic vegetation, better water clarity, and areas protected from wind and wave action. Because of these improvements, implementation of the proposed islands would have a cumulative effect of improving the overall value of the project area for fish and waterfowl.

H. Determination of Secondary Effects on the Aquatic Ecosystem

No significant secondary effects on the aquatic ecosystem would be expected from the proposed action.

III. FINDING OF COMPLIANCE WITH RESTRICTIONS ON DISCHARGE

1. No significant adaptations of the guidelines were made relative to this evaluation.

2. The proposed fill activity would comply with the Section 404(b)(1) guidelines of the Clean Water Act. The placement of fill is required to provide the desired benefits. Other alternatives would not provide the desired results.

3. The proposed fill activity would comply with State water quality standards. The disposal operation would not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

4. The proposed projects would not harm any endangered species or their critical habitat.

5. The proposed fill activities would not result in significant adverse effects on human health and welfare, including municipal

and private water supplies, recreation and commercial fishing. The proposed activities would not adversely affect plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic life and other wildlife would not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity, and stability and on recreational, aesthetic, and economic values would not occur.

6. To minimize the potential for adverse impacts, a couple of actions would be taken: fines would be either dredged and placed mechanically or, if dredged hydraulically, would be placed in bermed containment areas on the islands; rock groins would be used to stabilize the island shorelines; and notches have been incorporated into the modifications of wing dams 84 and 84. Since the proposed action would result in few adverse effects, no additional measures to minimize impacts would be required.

7. On the basis of this evaluation, I specify that the proposed disposal site complies with the requirements of the guidelines for discharge of fill material.

26 July 99
Date

KENNETH S. KASPRISIN
Colonel, Corps of Engineers
District Engineer

Appendix F

Correspondence/Coordination

The draft Definite Project Report/Environmental Assessment or Notice of Availability (*) was sent to the following.

Congressional
Sen. Russell Feingold (Middleton Office)
Sen. Rod Grams (Anoka Office)
Sen. Herbert Kohl (Madison Office)
Sen. Paul Wellstone (St. Paul Office)
Rep. Ron Kind (La Crosse Office)
Rep. Gil Gutknecht (Rochester Office)

Federal
Environmental Protection Agency (Chicago)
Department of Transportation (Homewood, Des Plains)
U.S. Coast Guard (St. Louis, St. Paul, La Crescent)
U.S. Geological Survey (Madison, Mounds View, Onalaska, La Crosse)
National Park Service (Omaha, St. Paul)
National Resource Conservation Service (Madison, St. Paul)
Advisory Council on Historic Preservation (Wash DC)
U.S. Fish and Wildlife Service - (Twin Cities - Hartwig, Kjos; Winona - Fisher, Drieslein)

State of Wisconsin

Department of Natural Resources (Madison - Meyers; La Crosse - Moe, G. Benjamin, Wetzel; Alma - Brecka)
Department of Transportation (La Crosse, Madison)
State Historic Preservation Office

State of Minnesota

Department of Natural Resources (St. Paul - Garber, Balcom, Johnson; Lake City - Johnson, Schlagenhaft, Dieterman; Winona - Gulden)
Minnesota Pollution Control Agency (St. Paul - Willet, Mader)
Department of Transportation
State Historic Preservation Office
Water and Soil Resource Board

State of Iowa

Department of Natural Resources (Des Moines - Szcodronski)

Local

City of Alma, WI*
City of Buffalo City, WI*
Village of Cochrane, WI*
Village of Kellogg, MN*
City of Wabasha, MN*
City of Winona, MN*
Buffalo County Commissioners*
Wabasha County Board of Commissioners*
Alma Post Office*
Buffalo City Post Office*
Cochrane Post Office*
Kellogg Post Office*
Wabasha Post Office*
Winona Post Office*
Winona County Board of Commissioners*

Other Interests

Minnesota-Wisconsin Boundary Area Commission (Hudson)
Upper Mississippi River Conservation Committee (Rock Island)
Sierra Club (Madison, Minneapolis)
Izaak Walton League (Edina)
Upper Mississippi River Basin Association (St. Paul)
Mississippi River Regional Planning Commission (La Crosse)
American Rivers
Upper River Services, Inc.
Mississippi River Revival
MARC 2000
Upper Mississippi Waterways Association

Media/Libraries

Buffalo County Journal*
Galesville Republican*
La Crosse Tribune
Waukon Newspapers*
KAGE Radio (Winona)*
KHME Radio (Winona)*
WLXR Radio (La Crosse)*
WKBT TV (La Crosse)*
WLAX TV (La Crosse)*
La Crosse Public Library
Winona Public Library
Cochrane - Fountain City Recorder*
Winona Daily News
Wabasha Herald
Rochester Post Bulletin
KQAL Radio (Winona)*
WLSU Radio (La Crosse)*
WKTY Radio (La Crosse)*
WXOW TV (La Crosse)*
Alma Public Library
Wabasha Public Library

Pool 5 Channel Management Study
Meeting Attendees - June 20, 1996

Dennis Anderson, Corps of Engineers
Gretchen Benjamin, Wisconsin Dept. of Natural Resources
Bob Drieslein, U.S. Fish and Wildlife Service
Scott Goodfellow, Corps of Engineers
Scot Johnson, Minnesota Dept. of Natural Resources
George Kletzke, Corps of Engineers
Dan Krumholz, Corps of Engineers
Gary Palesh, Corps of Engineers
Gary Wege, U.S. Fish and Wildlife Service

Minnesota Department of Natural Resources

Lake City Area Office
1801 South Oak Street
Lake City, Minnesota 55041

612\345-5601

August 28, 1996

Mr. Gary Palesh
St. Paul District
U.S. Army Corps of Engineers
190 Fifth Street East
St. Paul, Minnesota 55101-1638

Dear Mr. Palesh:

Re: Pool 5 Channel Management Plan

The Department of Natural Resources has reviewed the working draft of the Pool 5 Channel Management Plan Problem Appraisal Report (PAR) dated June 26, 1996. As requested, we have concentrated are review on the goals and objectives sections of the PAR.

It should be recognized by all parties involved in the development of the PAR that in some situations the goals and objectives listed for channel maintenance/navigation have the potential to conflict with environmental goals and objectives. It is our expectation that once we reach the point of discussing specifics for any individual project, a compromise may be needed to balance navigation needs with environmental needs. It is with this in mind that we suggest the qualifying phrase "to the greatest extent possible" be added to the channel maintenance/navigation goals or removed from the environmental goals. We believe either change would place both sets of goals on an equal playing field.

As we discussed at the last meeting regarding the Lower Pool 8 Channel Management Plan PAR, we believe language that discounts or foregoes consideration of possible water level management options should be removed from the text (example on page 12).

The pre-lock and dam maps of the navigational structures handed out at the last meeting are interesting but of limited use. A map with bathymetry, structures and flow vectors would be useful in screening training structures for future study. As it stands now, I would expect that from the environmental perspective, some

additional structures will be identified for further study once the hydrodynamic modeling and sediment transport modeling runs are available for review. Therefore, at this time we have no suggestions for changes to the screening table handed out at the last meeting.

We have numerous other editorial comments that we will convey informally in the form of margin notes for your consideration in the next draft of the PAR. Please pay special attention to the suggested modifications and additions to the biological objectives. If you have any questions please give me a call. Thank you for the opportunity to comment.

Sincerely,

Scot Johnson

Scot Johnson
CMP Coordinator

cc. Gretchen Benjamin, WDNR
Bob Drieslein, USFWS
Dan Dieterman/Tim Schlagenhaft, Fisheries, Lake City
Mike Davis, Eco Services, Lake City
Nick Gulden, Wildlife, Winona
Steve Johnson, Waters, St. Paul

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

WISCONSIN
DEPT. OF NATURAL RESOURCES

Tommy G. Thompson, Governor
George E. Meyer, Secretary
Donald R. Winter, District Director

State Office Building, Room 104
3550 Mormon Coulee Road
La Crosse, WI 54601
TELEPHONE 608-785-9000
FAX 608-785-9990

September 4, 1996

Mr. Gary Palesh
St. Paul District
U. S. Army Corps of Engineers Centre
190 Fifth Street, East
St. Paul, Minnesota 55101-1638

Subject: Working Draft Problem Appraisal Report - Pool 5 Channel Management Plan

Dear Mr. ~~Palesh~~ Gary:

Wisconsin Department of Natural Resources, Mississippi River staff has reviewed the Working Draft, Problem Appraisal Report, Pool 5 Channel Management Plan. The following comments describe concerns with the working draft issued June 26, 1996.

GENERAL COMMENTS

To begin with, there may be additional comments about the natural resources in Pool 5. During a discussion between Brian Brecka, Fisheries Manager at Alma, Wisconsin, we decided that some of the local people may have a better long term picture of the changes to the resources in Pool 5. Brian suggested we get those people together for a Pool 5 field trip and look at some of the resources concerns from their perspective. This field trip may occur in the near future. If it yields different information than what this letter provides, we will write a supplemental letter. There is a strong possibility that nothing will change, but I wanted you to know that we are doing this additional activity that may change some of our comments.

In many ways it appears that Pool 5 is very similar to Pool 8 as far as the needs of the natural resources. Upper pool 5 has the higher quality riverine habitat that most resource managers want to protect and conserve. The mid-pool contains many braided channels that appear to be filling with sand consequently reducing important habitat diversity. The lower pool has large areas of open water that would be helped by natural delta building processes. Essentially the same as Pool 8, conserve the upper one-third,

minimize sediment accumulation in the middle one-third and possibly enhance sediment delta building processes in the lower one-third.

SPECIFIC COMMENTS

Section 1.5.8 should probably include aerial boating study year 1995. I have just received the draft report summarizing the information of that year and comparing the data to the previous year's data. By the time this report is complete, the 1995 report will also be complete, so it is an appropriate addition.

Section 2.2 has either too much information or not enough depending on how you want to categorize this section. Under Section 2.2 (Water Resources), two major tributaries are described and two major natural resources. It seems more appropriate to either list just the tributaries or list the tributaries and all the important natural resources in Pool 5. A complete list of important natural resources would include but may not be limited to: Finger Lakes, Wiggle Waggle Slough, Moseman's Slough, West Newton Chute, Island 42, Belvidere Slough, Weaver Bottoms, Roebuck's Cut, Sand Slough (Cut), Lost Island Lake and Spring Lake.

One notable resource was missing from the description of the natural resources in Pool 5. I believe this description belongs in section 5.2.

> Moseman's Slough - Is a backwater complex, on the Wisconsin side of the channel, between river mile 750.5 and 748.3 that contains braided channels, large vegetative beds (submerged to emergent), and valuable overwintering habitat for centrarchids. This is a very popular winter ice fishing fishery. In the next 50 years, it would be important to protect this valuable habitat.

Two other notable resources were mentioned but deserve additional explanation on the importance of the area.

> Wiggle Waggle Slough - Is a valuable secondary channel that provides important riverine habitat away from the intense commercial and recreational traffic on the main channel. Fishery studies have documented high use by walleye and sauger in all stages of growth, spring spawning use by northern pike and numerous other nongame species uses. Increased sedimentation appears to be altering this important riverine habitat.

> West Newton Chute - Is a valuable secondary channel that provides important riverine habitat away from the intense commercial and recreational traffic on the main channel. A radiotelemetry study conducted on flathead catfish revealed that West Newton was preferred habitat of an adult female, and she only moved small distances within the chute. There may also be concern for channels that branch off West Newton Chute and flow into the Island 42 complex.

I hope you find these comments useful for the next working draft, Pool 5 Channel Management Plan. Let me know if you have questions about these comments, and we will get any additional comments to you as soon as is possible.

Sincerely,

Gretchen L. Benjamin
Mississippi River Planner

GLB:ak
c: Scot Johnson - MDNR, Lake City, MN
Bob Drieslein - USFWS, Winona, MN
Dan Krumholz - USACE, Fountain City, WI
Brian Brecka - WDNR, Alma

Pool 5 Channel Management Study
Meeting Attendees - October 8, 1996

Dennis Anderson, Corps of Engineers
Gretchen Benjamin, Wisconsin Dept. of Natural Resources
Brian Brecka, Wisconsin Dept. of Natural Resources
Dan Dieterman, Minnesota Dept. of Natural Resources
Scot Johnson, Minnesota Dept. of Natural Resources
Alan Robbins-Fenger, Minnesota Dept. of Natural Resources
Gary Palesh, Corps of Engineers
Steve Tapp, Corps of Engineers

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December 20, 1996

Mr. Gary Palesh
St. Paul District
U. S. Army Corps of Engineers Centre
190 Fifth Street, East
St. Paul, Minnesota 55101-1638

Subject: Working Draft - PAR, Pool 5, Channel Management Plan, Upper Mississippi River

Dear Mr. Palesh:

Thank you for providing a Working Draft - PAR, Pool 5, Channel Management Plan, Upper Mississippi River for review and comment. This letter contains comments from the Wisconsin Department of Natural Resources provided in a sequential order.

The word "dam" is missing on Page 1-3, in the paragraph numbered 1.5.3.

After some digging, Brian Brecka believes the correct spelling for Mozeman's is actually Mosiman's.

In section 2.5, Vegetation, the third paragraph has a mix of common names and one genus name for fresh meadow species. The names should be consistent, and if you want to stay with common names, sedge should replace carex.

Section 2.6 correctly identifies and defines the habitats associated with the Upper Mississippi River yet through the remainder of the document these terms are not used. For consistency reasons, the defined terms should be used throughout the document such as secondary channel instead of side channel.

Section 2.6.2 should contain information about the fish passage barrier that Lock and Dam 5 creates. Wisconsin Department of Natural Resources fish managers believe this dam provides the most significant barrier to fish passage in the St. Paul District. It is important to include this information in discussions about Pool 5 fish.

Following along with section 2.6.2, section 6.1.2 suggests that fish passage is beyond the scope of the District's Channel Management Program. Lock and Dam 5 is as much or more of a

structure to maintain navigation depths as the wing dams, closing dams and shore protection. Therefore, if this is not the proper program to pursue fish passage, then what is? We believe the Corps of Engineers is obligated to answer this question.

Section 6.3.3 should have two goals. The second goal should read "Recreation Goal #2: To sustain existing access route to recreational boat landings.

> There are eleven boat landings within the study area. Management actions will not include dredging boat accesses but actions should not jeopardize the existing depths at the landings.

Objective 6.4.2.1 should be more specific when referring to "natural river processes." This generic term may be appropriate for a goal statement but the river forces needed to obtain specific objective should be defined. Therefore, the objective should read "Remove or modify . . . and whose modification would substantially rejuvenate scouring and deposition forces of the river.

Section 6.4.2 should include three additional objectives. Objectives 6.4.2.6 and 6.4.2.7 should be written for Mule Bend and Krueger Slough because they are listed in section 5.2 as habitat concerns but where not included in the objective section. The other objective should be written for fish passage and should read 6.4.2.8 **Environmental Objective #8: Investigate and improve fish passage through Lock and Dam 5.** The description of this objective should be based on information contained in 2.6.2, 5.2.7 and 6.1.2.

Two closing dams on Table 8-1 may need additional screening. Wiggle Waggle slough may benefit from notching CD 5. CD 86 (at least I think that is the closing dam number for the side channel just downstream of Wiggle Waggle slough) is not mentioned in the table, but notching may also benefit that area. Therefore, both of these structure should move into the further screening category.

I hope these comments will be helpful with the preparation of a final document. Please let me know if you have any questions.

Sincerely,

Gretchen L. Benjamin

Gretchen L. Benjamin
Mississippi River Planner

c: Scot Johnson - MNDNR, Lake City, MN
Brian Brecka - WIDNR, Alma, WI
Bob Dreslein - USFWS, Winona, MN

Minnesota Department of Natural Resources

Lake City Area Office
1801 South Oak Street
Lake City, Minnesota 55041

612/345-5601

January 2, 1997

Mr. Gary Palesh, Technical Manager
U.S. Army Corps of Engineers, St. Paul District
190 Fifth Street East
St. Paul, Minnesota 55101-1638

Dear Mr. Palesh:

Re: Working Draft PAR, Pool 5 Channel Management Plan

The Department of Natural Resources has completed its review of the draft Pool 5 Channel Management Plan (CMP) Problem Appraisal Report (PAR) dated November 21, 1996. We appreciate the opportunity to participate in the CMP planning process. Please include our comments and suggested changes in the next draft of the PAR.

1.5.12 POOL 5 RECREATIONAL BEACH PLAN - Please include a schedule for completion of the Pool 5 Recreational Beach Plan.

1.5.15 WATER LEVEL MANAGEMENT STUDY - This section needs to be updated to reflect the December River Resources Forum activities.

2.3 GEOLOGY - Portions of the "driftless" area contain glacial outwash and pre-Wisconsin till deposits. Therefore, it contains "drift". However, geologist no longer use the word drift to describe glacial deposits. While we recognize that the word driftless is often used to identify the region, it is archaic in terms of describing the geology of the area. We suggest that you use the "Paleozoic Plateau Region" as described by Halberg(1984) and a brief history of the glacial periods to describe the geology of the area. We suggest "Bluffland Landscape" to identify the area.

The sentence starting with, "Such deposits...", does not read correctly in relation to the previous sentence. What deposits are you referring? Sandstone outcrops?

Last paragraph - Most of pool 5 is **not** mantled with loess. Most of pool 5 sediments would be considered glacial outwash, alluvium, palustrine or lacustrine deposits. Most of the surrounding upland **is** mantled with loess.

2.5 VEGETATION - American elm was a dominant tree species, but because of disease, mature elm trees are almost non-existent. Some reproduction can be found however.

Pool 5 no longer contains 1,560 hectares of marsh. As stated later in the paragraph, much of what was marshes is now shallow wind-swept lakes. A better description of why the change occurred and quantification of the remaining hectares of marsh should be completed.

The use of plant common names lends itself to the readability of this section at the loss of some clarity. What is the difference between arrowheads and duckpotatoe? What is meant by starweed? Is it water stargrass, star duckweed or something else? We suggest you compile a list comparing common names to Latin names and include the list as an appendix.

2.6 FISH AND WILDLIFE Secondary Channels - Where in Pool 5 does the navigation channel run through a secondary channel? It has been our observation that most banks in secondary channels are **un**protected.

Sloughs - Fish and wildlife habitat values **have** declined. Periodic strong water currents are rejuvenating to sloughs, scouring away fine grain deposits, often improving fish and wildlife habitat values.

River Lakes and Ponds - Vegetation abundance in river lakes and ponds is highly variable. Emergents are often restricted to the perimeter of the water body.

2.6.1 WILDLIFE - We're not clear on what criteria is used to differentiate major from minor wildlife species - abundance or importance? Perhaps the terms common and uncommon would be more appropriate. Mink and gray fox should be added to the list. Red fox is an open grassland species, not a woodland species. Otter are present but their numbers are not abundant.

Large numbers of pelicans and cormorants utilize Weaver Bottoms and a small population of sandhill cranes nest in McCarthy Lake WMA. A large heron rookery is found in the Zumbro River Bottoms.

Please check with the USFWS to see if recent waterfowl counts support the "millions" referenced here. Waterfowl use has declined sharply and a brief description of the reason for this decline should be included.

The last sentence is in error. The McCarthy Lake wetlands are important habitat for blanding's turtles, but not for wood and box turtles. To the best of our knowledge, wood and box turtles are not present on the WMA unit. It should be emphasized that the largest known population of blanding's turtles, a state endangered species, is in and along Pool 5.

The sand prairie and marshland north of Weaver Bottoms provide habitat for various grassland songbirds, including the state threatened loggerhead shrike.

The ottoe skipper butterfly is an upland species. The blue racer is an uncommon upland species found on the sand prairies.

2.6.3 Reptiles and Amphibians - why is this under a separate heading from Wildlife? Reptiles commonly found on the sand prairie include bullsnake, fox snake, blanding's turtle, eastern gartersnake and an occasional blue racer.

2.6.4.1 Mussels - Mapleleafs and hickory nuts **are not** common in Pool 5. Three horn warty backs **are** common in Pool 5.

2.7 Minnesota lists the following 10 mussel species:

Arcidens confragosus	Endangered
Plethobasus cyphyus	Endangered
Megalonaias nervosa	Threatened
Pleurobema coccinium	Threatened
Quadrula metanevra	Threatened
Tritigonia vericosa	Threatened
Eliptio dilitata	Special Concern
Lasmigona costata	Special Concern
Ligumia recta	Special Concern
Obovaria olivaria	Special Concern

2.7 A historic peregrine falcon nesting site is located on the cliffs in Latch State Park in Minnesota. This site was last occupied in 1988.

In this section it states there are 2 nesting sites/territories while section 7.2 it states that there are three. Please check with the USFWS for the latest information regarding the number of eagle territories in the area.

Bald eagles have an established winter night roost (Nov - April) in the backwaters of Zumbro River. They feed along the main channel during the day and night roost in the bottoms just downstream of the Finger Lakes.

Table 2-2 Please add the loggerhead shrike as a threatened species in Minnesota. Loggerhead shrikes have been seen in the sand prairie during the breeding season.

The wood turtle is listed as threatened in Minnesota, not endangered.

2.9 paragraph 2. - The use of the word withering appears incorrect.

2.10 Recreation - Compared to other areas, hunting and trapping is fair to good. Compared to past experiences in Pool 5, hunting and trapping is lousy. There is a need to recognize that habitat quality and use has declined in the pool.

Add birdwatching and canoeing to the list of recreational activities.

second paragraph, last two sentences - These sentences seem out of place and are included in other more pertinent sections.

The Kellogg-Weaver Dunes SNA contains 367 hectares, including both DNR and TNC lands. The table and text should be changed to reflect this larger area.

3.1 EARLY NAVIGATION PROJECTS, last paragraph - add - Sediments accreted between wing dams **and in cut off side channels,...**

3.3 9-FOOT NAVIGATION CHANNEL PROJECT, 5th paragraph - add - e) forest stand uniformity and successional changes related to a and b above.

6th paragraph - add - Impounded areas above the dams experience a leveling effect due to wind wave action eroding the high points and trapped sediments filling the old channels.

7th paragraph, last sentence - add - ...and building of islands and channel levee landforms.

4.2 PLANNING HORIZON - substitute "provide benefits" with "be functional".

4.4 FISH AND WILDLIFE HABITAT - Future conditions should include comments noting a continued increase in terrestrial habitat, loss of shallow vegetated aquatic habitat and a loss of diversity due to exotic species such as purple loosestrife and zebra mussels.

We look forward to reviewing this section once it is prepared.

4.5 RECREATION AND PUBLIC USE - It should be recognized that as fish and wildlife habitat decline; angling, hunting, trapping and other recreational activities dependent on habitat quality are likely to decrease.

Trapping should be included as one of the current recreational uses.

5.1.1 Roebuck's Cut - replace "small" with "short" to better describe the cut.

5.1.2 Mt. Vernon Light - more discussion should be provided relating the need to dredge this cut and the increased sediment transport efficiency of the river due to the Weaver Bottoms project.

5.2.1 Zumbro River - Local levees were built in the 1950s after the 1951 Zumbro River flood. The federal project incorporated portions of these local levees in 1972.

paragraph 2 - add "Prior to the Zumbro River Flood Control Project, Mississippi River flood events greater than the 10 year recurrence frequency utilized the lower Zumbro River floodplain for flood conveyance. During floods, the Zumbro River Flood Control Project blocks Mississippi River advective flow from moving across the floodplain raising Mississippi River flood stages upstream".

paragraph 3. - add as a last sentence "The Zumbro River's sediment contribution to the Mississippi would be reduced which could result in a reduction in maintenance dredging for the 9-foot Channel Project".

6.3.2.1. The International Large Floodplain Rivers Conference concluded that the disruption of the annual hydrograph and hydraulic processes was the cause for continued loss of habitat diversity. Please substitute "known" for "believed".

substitute - nutrient "inputs and recycling" for "dynamics".

6.3.3.2. There are many recreational activities that are aesthetic or quality of experience based. We propose a second (third?) Recreation Goal - "Increase the quality of recreational experiences related to the appreciation of riverine lifeforms and landforms".

6.4.3.2. insert- ...Access to private recreational facilities should not be adversely affected **permanently** by any proposed actions. There may be a need to temporarily affect a private facility.

7.1.1 Placement of fill along forested islands and shorelines is detrimental to some wildlife (ex. bald eagle day roosting habitat).

7.2.5.1 and 7.2.5.2 insert- **permanently** as described above.

8.1.2.2 Zumbro River Floodplain Restoration - please add the following rewrite to the beginning of this section:

"A conceptual plan to restore flow to many of the historic channels of the Zumbro River was discussed. Further development and implementation of the conceptual plan is dependent on participation and support of local citizens; federal, state, and local governments; as well as private organizations with interest and expertise in such projects. The plan would include fee title ownership, easements and cooperative agreements from willing landowners, on approximately..."

8.2.3 Language in this section implies that the 9-Foot Navigation Channel Project could play a role in restoring the Zumbro River Bottoms. What type of modifications to the Zumbro River Flood Control Project are within the purview and authority of the 9-Foot Navigation Project and do not require Congressional action? Please be specific and include details in the rewrite of this section.

Thank you for the opportunity to comment.

Sincerely,

Scot Johnson

Scot Johnson
Mississippi River Hydrologist

cc. Jim Cooper/Bill Huber, Waters, Region V
Steve Johnson/Alan Robbins-Fenger, Waters, St. Paul
Tim Schlagenhaft/Dan Dieterman, Fisheries, Lake City
Mike Davis, Eco Services, Lake City
Bonnie Erpelding, Wildlife, Rochester
Brian Brecka, WDNR, Alma
Nick Gulden, Wildlife, Winona
Gretchen Benjamin, WDNR, LaCrosse
Bob Drieslein, USFWS, Winona

PUBLIC MEETING
for the
POOL 5 CHANNEL MANAGEMENT STUDY

sponsored by the
ST. PAUL DISTRICT, CORPS OF ENGINEERS

at the
BUFFALO CITY MUNICIPAL BUILDING
BUFFALO CITY, WISCONSIN

7:00 P.M, THURSDAY, JANUARY 23, 1997

A public information meeting to discuss the Pool 5 Channel Management Study is scheduled to be held at the Buffalo City Municipal Building, Buffalo City, Wisconsin, at 7:00 p.m. on January 23, 1997. The Municipal Building is located at 245 East 10th Street in Buffalo City. The meeting is being held by the St. Paul District, Corps of Engineers.

The St. Paul District has initiated a Channel Management Program as part of the operation and maintenance of the 9-foot navigation channel on the Upper Mississippi River. The purpose is to evaluate how to use channel control structures (such as wing dams and closing dams) to reduce dredging requirements, provide a safer navigation channel, and to correct channel maintenance situations that are causing adverse effects to other uses of the river. An important component of the program is to identify and implement measures to reduce the adverse environmental effects of channel control structures and to restore natural river processes.

Studies are being conducted on an individual pool or river reach basis. The current study is addressing all of pool 5. The primary purpose of the public meeting is to identify and discuss channel maintenance, navigation, environmental, recreational, or other problems in pool 5 that potentially could be addressed by modification of channel control structures. The meeting will be conducted as informally as practical to facilitate the exchange of information and ideas between the Federal and State agencies involved in the study and the public.

The Pool 5 Channel Management Study is not addressing Weaver Bottoms. Weaver Bottoms is the subject of a separate evaluation being conducted by the Weaver Bottoms Task Force. The recommendations of the Weaver Bottoms Task Force will be taken into consideration during the formulation of a channel management plan for the remainder of pool 5. This public meeting <u>will not</u> be a forum for discussing Weaver Bottoms or the study efforts of the Weaver Bottoms Task Force.

If you are unable to attend the meeting, feel free to contact Gary Palesh, St. Paul District technical manager, at (612) 290-5282 if you wish to receive information concerning any aspect of the Pool 5 Channel Management Study.

CENCS-PE-M 27 January 1997

MEMORANDUM FOR RECORD

SUBJECT: Pool 5 Channel Management Study

1. On 23 January 1997, the initial public meeting for the subject study was held at the Community Center in Buffalo City, Wisconsin. The purpose of the meeting was to inform the public of the study and to solicit their input concerning channel control structures that may be causing environmental, recreational, and other problems in pool 5, the solution to which may lie with modification of channel control structures or other related actions. The meeting was attended by 16 members of the public (enclosure 1).

2. District representatives in attendance besides the undersigned included Dennis Anderson (PE-M), Scott Goodfellow (PE-H), Dan Krumholz (CO-MR), Dave Peck (CO-MR), and Jerry Lee (CO-MR). Agency representives in attendance included Bob Drieslein (USFWS), Eric Nelson (USFWS), Brian Brecka (WDNR), Scot Johnson (MDNR), and Dan Dieterman (MDNR).

3. Following introductions, I provided background information on the study and the reasons for the public meeting. Most of the meeting centered around identifying environmental and recreational problems in pool 5. We used a series of slides of 1994 aerial photographs of pool 5 to stimulate the discussion. A slide of a particular section of pool 5 would be put on the screen and the public asked to identify environmental and recreational problems specific to that area.

4. The following meeting notes were prepared by Dennis Anderson.

A. GENERAL COMMENTS:

o A concern was expressed about the habitat quality of riprapped banks. The effects on turtles were discussed: turtles climbing over riprap get trapped in the crevices that are created. In addition, the riprap is a barrier to land based wildlife, specifically bank dwelling wildlife, like muskrat. It was suggested that riprapped banks be sinuous to increase habitat diversity. It was also suggested that consideration should be given to placing soils on top of the riprap to increase terrestrial habitat values.

o Concerned about the decline in vegetation throughout the pool.

B. REACH SPECIFIC COMMENTS:

(1) Reach from approximately river mile 752.5 to 750.0.

o Concerned about the stability of the head of Island 40.

o The rock pile that used to be the head of the island was identified as a potential safety concern.

o Concerned that Wiggle-Waggle Slough is now returning to the main channel at a more upstream location.

o Recreational safety concern for wing dam in the backwater downstream of Wiggle-Waggle Slough

(2) Reach from approximately river 750.0 to 748.0 - including Island 42, Mosimans Slough, West Newton Chute.

o Mosimans Slough has historically been a good winter fisheries that has declined. Concerned about Mosimans Slough becoming shallower. An embayment off of Mosimans Slough near the main channel has good water depths for winter fishery habitat, but the mouth has been occluded with sand and freezes to the bottom in the winter. There is concern that this is becoming a trap for fish.

o Concerned with sand closing off the mouth of a small channel located downstream of Mosimans Slough (River Mile 748.4). The riprap that was present in the area is disappearing and may be one of the reasons for the small channel closing off.

o Concerned with sand closing off the mouth of a small channel located upstream of the Mule Bend placement site. (River Mile 748.4).

(3) Reach from approximately river mile 748.0 to 746.0 - including Belvidere Slough, Roebucks Run, Krueger Slough, Probst Lake.

o Concerned with the amount of sand entering the Belvidere Slough area. Indicated that extensive amount of sand has entered the area in the last five years.

o Concerned about the increase in depth and width of the mouth of Roebucks Run. The closing structure across the mouth appears to be disappearing rapidly. An island immediately downstream of the mouth has disappeared because of the excessive flow.

o Concerned about the large sandbar downstream of Roebucks Run. Very abrupt change in depth, makes it a safety hazard for recreational boats and its easy to get stuck on the bar.

o Probst Lake one of the best winter fishing area left in the pool. Concerned about the increasing width of the cut off Belvidere Slough entering Probst Lake. Sand has been depositing in the upper end of the lake. Also concerned about the sand bar forming in lower end and its impact on recreational access.

o Concerned with recreational access in Murphy's cut - channel that was dredged near the intersection with Old John's Ditch has filled in. An extensive sandbar has also developed across the mouth of Murphy's Cut.

o The channel into Island 42 near river mile 748.3 has been effectively closed off by a sandbar and trees. A wingdam near the mouth may be causing this problem.

(4) Reach from approximately river mile 746.0 to 743.0 - including Lost Island Lake, Sand Run.

o Can no longer navigate small boats from Belvidere Slough to the main channel through Sand Run. The lower end of Sand Run has become totally occluded. Flow through Sand Run is now directed into Lost Island Lake, through the two rock-lined channels that were done as part of Weaver Bottoms project. One of the cuts has water depths in excess of 20 feet on the lakeward side.

o A large opening has formed on the eastern side of Lost Island Lake and there is an extensive, impassable sand flat being formed in Lost Island Lake.

o Mud Lake, located near the mouth of the cut entering Lost Island Lake at river mile 744.7, was historically as productive a winter fisheries as Probst Lake. Sand entering through this secondary channel into Lost Island Lake, however, has cut-off the lower end of this small lake, reducing its fisheries value.

o There are a lot of sand shoaling problems in the Buffalo City area with respect to effects on recreational boat access.

(5) Reach from approximately river mile 743.0 to 741.0 - including Spring Lake area.

o Concern expressed regarding the amount of sand entering the Fountain City Bay Culverts and the operation of the culverts (Why aren't they being closed in high water? What is the status of closing them down in the winter to improve habitat conditions for fish in Fountain City Bay?).

o Concern about the general decline of the fisheries in this area.

(6) Reach from approximately 741.0 to 738.3.

o It was indicated that the fishing on the wingdams along the Minnesota side is poor, to non-existence. The ends of the wingdams have good current and are not covered by sand. The landward portions have filled in and depths are relatively shallow and uniform.

o It was indicated that the fishing on the wingdams along the Wisconsin shore is excellent. Depths are greater and more diverse.

5. A memorandum for record prepared by Dave Peck is enclosed (enclosure 2).

6. In conclusion, the public meeting was highly productive with the local citizens providing valuable input towards the identification of environmental and recreational problems in pool 5.

Encl

Gary Palesh
Technical Manager

RECORD OF ATTENDANCE

Meeting Pool 5 Channel Mgmt. Study Date 1/23/97

This information will be used for the purpose of knowing who attended this meeting.
Please include your address if you wish to be on the project mailing list. Thank you.

NAME (please print)	ADDRESS (optional)	REPRESENTING
ROBERT SIEKER	530 S MAIN FOUNTAIN CITY	WIS CONSERVATION CONG
JAY Motszko	614 W Lincoln Arcadia WI 54612	
Jim [illegible]	Box 54 [illegible] WI 54756	
GAYLE LEWIS	S 2322 CTY RD OO COCHRANE, WI 54622	
Scott Auer	1133 S. River Rd Cochrane, WI 54622	
CLIFFORD BURMEISTER	BUFFALO CITY	
NEIL KELLER	1325 S. RIVER RD. BUFFALO CITY	
Keith B. Larson	#17 - Deer Cove Wabasha MN 55981	
[illegible]	15 Deer Cove Wabasha MN 55981	
BARRY AUER	1145 S. RIVER Rd Buffalo city WI 54622	
Luann Rinn	181 W. 7th ST Buffalo City, Wi 54622	
DON EVANSON	RR1 BOX 329A MINNESOTA CITY MN 55959	

Encl 1

RECORD OF ATTENDANCE

Meeting Pool 5 Channel Mgmt. Study Date 1/23/97

This information will be used for the purpose of knowing who attended this meeting. Please include your address if you wish to be on the project mailing list. Thank you.

NAME (please print)	ADDRESS (optional)	REPRESENTING
Michael Delong	Large River Studies Center Biology Dept. Winona State Univ. Winona MN 55987	LRSC, Winona State
Eric Nelson	Upper Miss Refuge Winona	USFWS
Scot Johnson	1801 S Oak, Lake City	MDNR
Bob Drieslein	Upper Miss Refuge 51 E. 4th St Winona	USFWS.
Leo L. [illegible]	315 Vista Dr. Alma, Wi 54610	
Max Bachhuber	Alma, WISC 54610	
Gene Glomski	Buffalo City 54622	Sport Guide Service
DAN DIETERMAN	MN DNR LAKECITY	

NCSCO-MRPO

01/23/97

MEMO: Pubic Meeting, Cochrane, Buffalo City, Wi.
Pool # 5 Study, 18:00 hrs. Community Hall

Attended: 28 citizens from community and agencies.

Subject: Study of Pool 5, Beginning stages through final construction stages, year 2001.

* The Corps is looking at placing new and restructuring the existing structures in pool 5 within the next 5 years. This may involve designing new structures to divert flows through existing cuts to supply more aeration and better the vegetation in back waters throughout the pool.

* Beaches; Were discussed briefly but were not the main topic of discussion. After Mr. Palesh mentionioned beaches they were not discussed any further until after the meeting between Scott Johnson and myself. This was just make him aware of publics views.

* Dredging; A description of the area in pool 5 was given to the public on the 5.9 miles of dredging cuts. This appears to be one continuous cut from Island 42 down river to Minneiska.

* Concerns; A concerned citizen brought up the fact that he has been observing the Rip-Rap that the Corps and Contractors have placed on bankline protection in the past. He believe's this is a problem for wildlife especially turtles. He says the turtle travels over the Rip-Rap and because of the size of the stone the turtle will lodge itself between the rock and become immobile. His solution to this problem is; have the Corps look into placing top soil over the Rip-Rap so that not only wildlife but also human passage may be traversed easier.

* Whigle Whigle Slough below Lock and Dam # 4; This seems to have public awareness. One citizen says that this area has been impacted since the 1965 flood. There is a rock formation on the upper end of Is. 40 that was in the 1960's the head of Is. 40. Since then the Island has scoured down river a considerable amount. This citizen thinks the head of the island should be restored to original which will divert the water trough Whigle Whigle slough instead of diverting flows to the channel side. Also seems to be a navigation hazard to recreational boaters. At the head of the slough Gary Palesh says the Corps is looking at restructuring and opening the center of the closing dam. Citizens say this dam does not exist. Further down into the cut where is filters into a small lake the outer island has breached from high flows and is cutting a channel on the channelward side. This should be closed to divert flows out the lower end of Whigle Whigle slough. The Closing dam behind the Island at 751.5 seems to be in good condition. The Corps is thinking of breaching a hole to provide more flow behind the island.

ENCL 2

* Mosimans Cut; A proposal from the Corps is to study the flows entering this cut. The entrance to the cut is very shallow and recreational boaters are hitting lower units when crossing the closing dam in the entrance of the cut. Also once a boat is into the cut water levels shallow to the point of no access to Mosimans cut. Just below the entrance to the cut a slough juts upstream. This is very good habitat for winter fish. The concerns by the Wisconsin DNR is; Once the fish enter this lake for winter refuge the entrance may freeze solid to the bottom and cut of the oxygen supply. This could impact a large amount of pool 5's fish. Proposal is to study the flow, restructure the entrance so the flow will naturally scour the entrance to this lake and also supply enough flow to open the lower end for recreational boating but a concern should be placed on the impact downstream towards the Great River Harbor and Pomme De Terre Slough so this change in structure at the head of Mosimans does not impact lower access to Great River Harbor.

* Island 42; At the head of Island 42 holding area there is a small slough that leads back behind the holding are in the fingers of Island 42. The public says this slough has closed off due to a wing dam structure just upriver from the entrance. Also another citizen expressed that there are snags that may be impacting the flows at the entrance and diverting material into the entrance. NOTE: Proposal; IF the structures upstream are breached we may want to close them again. This may be what is impacting upper West Newton Chute dredge cut. The flows are forced down the right descending bankline and just below the cut entrance were the groin dams start the material is forced across the river to Belvedere cut. This I believe is what is causing this sand bar to extend into the channel.

* Half Moon Landing; The public says that this area is filling in with sandy material again. It was dredged in the past and citizen John Griffins explained that shortly after the dredge completed this cut it started to fill in again. Apparently structures at the entrance must not be working to divert flows correctly down the channel and deposits of sand are being forced back into Half Moon Cut.

* Probst Lake; The Corps is looking at closing the flow to the upper end of this lake. This would be on the right descending side of Belvedere cut. This opening has been progressively getting worse since the late 1970's. Probst is a very good fish habitat area. With the upper end being open material is being forced to the lower end of the lake and closing it off. Also there is a small slough that runs east out of the lake and comes out at the lower end of Robucks Cut. Due to the flows entering Probst more material and more flow has closed off several small lakes that provide fish habitat in the fingers of this chain of islands. Access from the lower end is very shallow.

* Robucks Cut; Corps is looking at this from the navigational side. There is an outdraft forcing towing traffic to be drafted down into Robucks. From channel marker 746.6 to the head of the island should be restructured and the head of the island should be brought back to original in order to cut the flow entering this cut. The main closing dam across Robucks has been destroyed or has washed out. This has increased the flows going through Robucks and is forcing material into Pomme De Terre Slough. The left descending bankline of Pomme De Terre is gradually filling in with material. Because this is one of the only access's to Buffalo City at present due to the closing of Sand Run and material in the future is going to continue to be deposited through this cut possible there will be no access to Buffalo City in the future other than the larger inlets. Proposal should be to restructure entrance, restructure towhead of island (right descending bank of robucks cut) and give Pomme De Terre Slough a year or two to see what the flows are doing. While this is happening maybe Sand Run could be opened to supply a better flow into Lost Island Lake.

* Sand Run; Since the closing of two cuts interior of sand run the lower end or Buffalo City entrance has completely closed off. I am not sure whether this was caused by the cuts being closed or the fact that material is being forced through Robucks at higher than normal rates and forcing this material to back eddie into the Buffalo City entrance of Sand Run.

* Lost Island Lake; Sand flats are forming since construction in Sand Run throughout the whole lake. This has always been flat but according to public concerns this happening more rapidly in the past 10 years.

* Channel entrance to Lost Island; Lower end of Lost is. holding area has close off. The public is concerned about entering this cut. Behind Lost Island holding area is another fish habitat that has always been good for winter fishing. At the present time boaters cannot access due to shallowing conditions.

* Spring Lake Project; The Corps is studying the lower finger islands at Spring Lake and in the future plans on reconstructing these islands. These island provide wind fetch to the spring lake area and the dike system for Lock & Dam 5.

* MN 14; The public was made aware of the construction that will take place summer of 1997 at MN 14. The upper discharge for Weaver Bottoms is going to be widened out and slanted up into the bottom. This should supply a slower rate of discharge to the channel therefore help the towing industry in navigating Minnieska corner also with flows being slowed in time should scour some of the sand bar that has been building on the left descending side of channel.

* Mount Vernon; Gary Palesh explained that dredging may have to occur in this area because of the Weaver discharge. But studies are taking place to determine where the material should end up. Due to the lack of hold areas in this reach the river may have to be restructured to keep the material up river in Lost and Fisher Island holding areas for future removal.

* Wing Dam Lower Pool 5; From the publics point of view the dams in the lower pool are still in good shape. One concerned citizen said although the dams appear to be in good condition he could not understand why the fishing in this area was not good. After the meeting I talked with another local about the fishing in this area. His comments were the only reason why the fishing was not good on these dams was because of the flows. When the flows are 20,000 to 30,000 in the upper reaches of the pool down river on these dams flows are only running 5,000 to 7,000. The fish need the flow to feed and it is just not there during the summer months. Although this citizen explained spring fishing in this area was exception this past summer.

CORPS PROGRAM:
* Problem appraisal period - 05/97
* Feasibility study - 09/98
* Engineering phase - 09/99
* Construction phase - 1999 - 2001

GOAL: COE's goal is to enhance vegetation throughout the pool. Retain existing structures but also study these structures to enhance flow to make the river system environmentally friendly to all who navigate.

Lock 5 dike culverts; Public was wondering why the tubes were not closed during high water to prevent sand deposits in to the bottoms of Fountain City bay. DNR was looking into this reason public awareness in Cochrane, Buffalo City and Fountain City has developed two different sides. One saying these culverts should be opened the other saying the should be closed. This seems to stem around whether you are a fisherman or duck hunter. This issue is being researched.

David R. Peck
Waterways

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

REPLY TO
ATTENTION OF

February 25, 1997

Management and Evaluation Branch
Engineering and Planning Division

MEMORANDUM FOR: River Resources Forum

SUBJECT: Pool 5 Channel Management Study

Enclosed is the draft Problem Appraisal Report (PAR) for the Pool 5 Channel Management Study. The Pool 5 Channel Management Study is being conducted under the St. Paul District's Channel Management Program as outlined in Tab 7 of the Channel Maintenance Management Program. The study began in June 1996, and interagency coordination to date has been with the On-Site Inspection Team representatives. Study efforts have focused on identifying channel maintenance, environmental, navigation, and recreation problems; identifying goals and objectives for the study; and identifying and screening potential alternatives to meet those goals and objectives. The guidelines developed by the Interagency Hydraulic Evaluation Team are being used in the study process.

The PAR identifies the problems, goals, and objectives for the study area and the alternatives that will be evaluated in detail during the next planning phase (feasibility). It can be considered a planning "checkpoint" to insure that all interests and concerns related to management of the navigation channel have been identified, and to insure consensus with goals and objectives developed for the study and general agreement with alternatives that will be evaluated further.

A public meeting for the study was held in Buffalo City, Wisconsin, on January 23, 1997. The meeting focused on the identification of environmental and recreation problems in pool 5. The problems and concerns identified by the public at that meeting have been incorporated into the draft PAR.

We request that comments on the draft PAR be provided by March 31, 1997. If you have any questions, please contact Mr. Gary Palesh at (612) 290-5282.

Sincerely,

Charles P. Spitzack
Chief, Management and Evaluation Branch
Engineering and Planning Division

Enclosure

WISCONSIN
DEPT. OF NATURAL RESOURCES

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Tommy G. Thompson, Governor
George E. Meyer, Secretary
Donald R. Winter, District Director

State Office Building, Room 104
3550 Mormon Coulee Road
La Crosse, WI 54601
TELEPHONE 608-785-9000
FAX 608-785-9990

March 27, 1997

Mr. Gary Palesh
St. Paul District, Corps of Engineers
190 Fifth Street East
St. Paul, MN 55101-1638

Subject: Pool 5 Channel Management Study - Problem Appraisal Report

Dear Mr. Palesh:

The Problem Appraisal Report, Pool 5 Channel Management Plan has been reviewed by appropriate Wisconsin Department of Natural Resources staff and we would like to provide the following comments.

The report is a good representation of the concerns and potential management options for Pool 5. Members of the OSIT were not able to eliminate many of the channel control structures from further study because they are still many unanswered questions. Once we understand the dynamics of the structures we should be able to make better predictions about what would be best for the resources of concern in Pool 5. We appreciate the fact that the Corps' will provide further analyses for these structures and look forward to the subsequent results.

Please find attached to this letter, comments from Brian Brecka. Thank you for providing the Draft Problem Appraisal Report for comment.

Sincerely,

Gretchen L. Benjamin
Mississippi River Planner

c Scot Johnson - MDNR, Lake City, MN
Bob Drieslein - USFWS, Winona, MN

WISCONSIN
DEPT. OF NATURAL RESOURCES

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Tommy G. Thompson, Governor
George E. Meyer, Secretary
Scott A. Humrickhouse, Acting Regional Director

Brian Brecka, Mississippi River Biologist
DNR, Buffalo County Courthouse, P.O. Box 88
Alma, WI 54610-0088
TELEPHONE: 608-685-6221
FAX: 608-685-6213

March 25, 1997

RECEIVED
MAR 26 1997
DNR La Crosse Area

Gretchen Benjamin
Wisconsin Department of Natural Resources
3550 Mormon Coulee Road
LaCrosse, WI 54601

Dear Gretchen,

I have reviewed the draft Problem Appraisal Report, Pool 5 Channel Management Plan. Please incorporate in your response any of my comments that you believe appropriate.

GENERAL COMMENTS

Overall, the document is beginning to address the problems that have been expressed, either from state and federal agencies or from the public. It pleased me to see the concerns from the recent pubic meeting brought into the document. I found Section 4 (future conditions) quite interesting; it appeared that much thought and effort went into the writing. It is this type of discussion that is needed as we as a state agency proceed in managing the Mississippi River.

SPECIFIC COMMENTS

Section 2.4. Paragraph 1. Sentence 2. The word "will" appears to be wrong.

Section 2.6.1. Paragraph 3. Consider deleting the discussion about the Whitman Bottoms Floodplain Forest. This area is located in Pool 5A, not Pool 5.

Section 2.6.3.1. You may consider adding the mussel species that are legally harvested in Wisconsin.

Section 4.4. The word "planform" is used in this section. You may want to define this word or choose another.

Section 4.4.1.1. I believe the word "Roebuck's" should replace "Roebucks". This occurs in other sections as well.

Section 4.4.1.2. Paragraph 2. The word "Galle" should be capitalized. Page 4-7, Paragraph 2. The sentence "At present no areas in Lost island have ..." should read "At present no areas in Lost Island Lake have ...". Also, same paragraph, 2nd to last sentence. "Occur" is missing an "r".

Section 4.4.2. Paragraph 1. The word "amount" is misspelled.

Section 4.4.4. Sentence 5. The word "quality" is misspelled. Also, 2nd to last sentence, the word "however" is misspelled. Also, last sentence, the word "their" is misused.

Section 4.5. Paragraph 1. The word "picnicking" is misspelled.

Section 5.2.10. Paragraph 2. Last sentence. The first "increase" should be "increased".

Section 5.3. We suggest adding the following recreational boat access to your list: **Primary upstream entrance to Spring Lake known locally as the "S-turn" entrance.** Local residents have at great length discussed this entrance with us.

If you find some of the suggestions too critical or inappropriate, please disregard. However, I support the comments if future documents will be easier to read and more understandable. Please call me at 608-685-6221 if you have any questions or would like to further discuss the Problem Appraisal Report.

Sincerely,

Brian Brecka, Mississippi River Biologist
Wisconsin DNR - Alma

Minnesota Department of Natural Resources

Lake City Area Office
1801 South Oak Street
Lake City, Minnesota 55041

612/345-5601

April 9, 1997

Mr. Gary Palesh, Technical Manager
U.S. Army Corps of Engineers, St. Paul District
190 Fifth Street East
St. Paul, Minnesota 55101-1638

Dear Mr. Palesh:

Re: Draft Problem Appraisal Report, Pool 5 Channel Management Plan

The Department of Natural Resources has completed its review of the draft Pool 5 Channel Management Plan (CMP) Problem Appraisal Report (PAR) dated February 1997. We offer the following comments for your consideration:

2.2.2 **Zumbro River** Please provide a reference to the sand load estimates given in the text. Suspended sediment typically does not include sand size particles. USGS (Tornes, 1988) sediment work was restricted to suspended sediments.

2.2.3 **Whitewater River** The NRCS recently completed a detailed sediment budget for the Whitewater River which could provided additional information to this section.

4.4.1.1 **Training Structures** The sentence: "This increased low flow velocities and caused erosion in the main channel" is not coherent.

page 4-5, para.1. The statement: "On a navigation pool and floodplain reach scale, the effects of training structures are minimal for existing river conditions" needs to be clarified and supported by references. We believe that the **cumulative** effects of wing dams, closing dams, dikes, maintenance dredging and revetments has had a profound influence on the floodplain geomorphic processes and landforms at these scales.

4.4.1.2 **Sedimentation** page 4-5, para 1. Please explain how the 1-dimensional water and sediment model used by Simon could possibly predict a 3 dimensional "river scene" 50 years into the future.

page 4-7, para.1. How will the trend of increased hydrodynamic connectivity continue if three out of the four navigation objectives in this plan will essentially reduce connectivity?

4.4.3 **Plant Community** This section should be expanded to fully explain and differentiate between emergent and submergent aquatic plant issues and needs. Paragraph 3 in the Water Level Management PAR Vegetation Section would be a good start in these discussion.

Thank you for the opportunity to comment. The Department of Natural Resources looks forward to participating in the next step of the planning process.

Sincerely,

Scot Johnson

Scot Johnson
Mississippi River Hydrologist

cc. Jim Cooper/Bill Huber, Waters, Region V
Steve Johnson/Alan Robbins-Fenger, Waters, St. Paul
Tim Schlagenhaft/Dan Dieterman, Fisheries, Lake City
Mike Davis, Eco Services, Lake City
Nick Gulden, Wildlife, Winona
Bonnie Erpelding, Wildlife, Rochester
Gretchen Benjamin, WDNR, LaCrosse
Brian Brecka, WDNR, Alma
Bob Drieslein, USFWS, Winona

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

REPLY TO
ATTENTION OF

May 6, 1997

Management and Evaluation Branch
Engineering and Planning Division

MEMORANDUM FOR: River Resources Forum

SUBJECT: Pool 5 Channel Management Study

Enclosed is the final Problem Appraisal Report (PAR) for the Pool 5 Channel Management Study. The Pool 5 Channel Management Study is being conducted under the St. Paul District's Channel Management Program as outlined in Tab 7 of the Channel Maintenance Management Program.

The PAR identifies the problems, goals, and objectives for the study area and the alternatives that will be evaluated in detail during the next planning phase (feasibility). It can be considered a planning "checkpoint" to insure that all interests and concerns related to management of the navigation channel have been identified, and to insure consensus with goals and objectives developed for the study and general agreement with alternatives that will be evaluated further.

The draft PAR was circulated for review on February 25, 1997. Comments were received from the Wisconsin and Minnesota Departments of Natural Resources. The comments and responses are contained in the coordination appendix of the final PAR.

The study will continue into the feasibility phase with primary coordination still taking place at the On-Site Inspection Team level. A draft Definite Project Report which will contain recommended courses of action is scheduled for completion in July 1998.

If you have any questions, please contact Mr. Gary Palesh at (612) 290-5282.

Sincerely,

/S/

Enclosure

Charles P. Spitzack
Chief, Management and Evaluation Branch
Engineering and Planning Division

Minnesota Department of Transportation

Office of Freight, Railroads, & Waterways
925 Kelly Annex, MS470
395 John Ireland Blvd.
St. Paul, MN 55155

Phone: 612/ 296-0355
Fax: 612/ 297-1887

June 16, 1997

Mr Gary Palesh
Technical Manager
U.S. Corps of Engineers
St. Paul District
190 Fifth Street East
ST. Paul, Minnesota 55101-1638

Dear Gary,

I have reviewed your memorandum regarding the Pool 5 Channel Management Study. The best of both worlds would be dredging where needed and creating islands for environmental benefits in the same locations using the dredged material.

It seems that a major problem is the erosion resulting from high water, winds and wave action. Using rip-rap in the creation and maintenance of these islands must have a positive result and benefit to the environment as well as reducing the need for additional dredging. I realize there is an additional cost in bringing in rip-rap, but that might be somewhat offset by reducing the frequency of dredging.

As you stated, by using some of these techniques earlier would have resulted in several islands having already been built to accomplish the needs for the environment.

I would also suggest that islands be created to help direct the flow of the channels. This could aid in keeping fish channels open in low current areas. Also the vegetative plantings of flood resistant species (if that is possible) would supplement or take the place of some of the rip-rap.

Thanks for the opportunity to comment on your study plans.

Sincerely,

Dick Lambert

Dick Lambert
Director
Ports & Waterways

CEMVP-PE-M 26 September 1997

MEMORANDUM FOR: See Distribution

SUBJECT: Pool 5 Channel Management Study

1. Dennis Anderson and Scott Goodfellow have conducted an initial assessment of the channel control structures in pool 5 (enclosed). The purpose was to identify those structures we may want to modify for environmental and/or navigation purposes. Please review this information and provide us any comments you may have by November 30, 1997.

2. After we receive your comments, we will schedule a meeting (if necessary) to identify those structures upon which we will focus our further study efforts. If we accepted Dennis and Scott's assessment as is, we would eliminate 99 structures from further evaluation and study 69 structures for modification, either for environmental purposes, navigation purposes, or both.

3. If you have any questions specific to their assessment, please contact Dennis or Scott. If there are any other questions, please give me a call.

Encl

Gary Palesh
Technical Manager

Distribution:
Bob Drieslein, USFWS
Gretchen Benjamin, WDNR
Brian Brecka, WDNR
Scot Johnson, MDNR
Dan Dieterman, MDNR
Dan Krumholz, COE
Dennis Anderson, COE
Scott Goodfellow, COE

Minnesota Department of Natural Resources

Lake City Area Office
1801 South Oak Street
Lake City, Minnesota 55041

612/345-5601

December 1, 1997

DEC - 2 1997

Mr. Gary Palesh, Technical Manager
U.S. Army Corps of Engineers, St. Paul District
190 Fifth Street East
St. Paul, Minnesota 55101-1638

Dear Mr. Palesh:

Re: Pool 5 CMP - Bathymetry and Training Structure Color Plates

The Lake City Area Office has reviewed the 40 color plates and Corps' initial assessment of the channel control structures in Pool 5.

In our review we noticed that the control structure modifications identified by the Corps for environmental purposes were almost exclusively wing dams. While we recognize that wing dam notching may create a localize improvement in habitat diversity, it is our belief that an increase in the redistribution of flow throughout the floodplain is of greater systemic importance for restoration and maintenance of habitat diversity.

We request the following closing structures be added to the list of structures to be evaluated for modification or removal for environmental purposes:

CD	River Mile	Description
5	752.6R	Head of Upper Wiggle Waggle Slough
28	752.0R	Head of Lower Wiggle Waggle Slough
4	750.0R	Head of West Newton Chute
11	748.8L	Slough into Upper Mozimans Slough
6	748.1L	Slough above head of Belvedere Slough
1	748.0L	Head of Belvedere Slough
2	748.0L	Head of Belvedere Slough
41	745.7L	Head of Sand Run
59	745.6R	Below Fisher Island
1	741.2L	Head of inundated unnamed channel?
8	741.2L	Head of inundated unnamed channel?
32	739.8R	Head of inundated unnamed channel?
31	739.5R	Head of inundated unnamed channel?
40	739.0L	Head of inundated unnamed channel?

Other observations include:

* Bathymetry and control structure locations were often offset suggesting a problem in registration or GPS resolution.

* Many of the closing dams we may be interested in modifying or removing were not on color plates.

* In general, necessary bathymetric data is missing from side channels, behind closing structures and other areas any distance from the navigation channel.

* A set of smaller scale plates depicting the entire floodplain's bathymetry, structures and flow vectors under various discharges is an essential tool to better evaluate potential control structure modifications.

* Rebuilding or enlargement of wing dams are suggested without adequate discussion of the perceived navigation problem.

* Notching of a wing dam buried by sand will not produce the desired effects if there is inadequate flow to scour.

* Modification of the Weaver Bottoms closing structures should be visited once the final monitoring report is out.

* WD 102 may effect flow into Lost Island and should be on the list for possible modification for environmental purposes.

* The distribution of mussels is not well known in Pool 5. In areas of control structure modification, particularly in areas downstream of notched wing dams, mussel surveys should be completed.

* The large number of possible wing dam rebuilds and enlargements identified in the preliminary Corps assessment will lead to further canalization of the Upper Mississippi River and a further degradation of aquatic habitat in the long-term if implemented.

Thank you for the opportunity to comment. The Lake City Area Office staff looks forward to participating in the next step of the planning process.

Sincerely,

Scot Johnson

Scot Johnson
Mississippi River Hydrologist

cc. Jim Cooper/Bill Huber, Waters, Region V
Tim Schlagenhaft/Dan Dieterman, Fisheries, Lake City
Mike Davis, Eco Services, Lake City
Nick Gulden, Wildlife, Winona

WISCONSIN
DEPT. OF NATURAL RESOURCES

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Tommy G. Thompson, Governor
George E. Meyer, Secretary
Scott A. Humrickhouse, Regional Director

Brian Brecka, Mississippi River Biologist
DNR, Buffalo County Courthouse, P.O. Box 88
Alma, WI 54610-0088
TELEPHONE: 608-685-6221
FAX: 608-685-6213

January 14, 1998

Mr. Gary Palesh, Technical Manager
U.S. Army Corps of Engineers, St. Paul District
190 5th Street East
St. Paul, MN 55101-1638

Subject: Pool 5 Channel Management Plan
Bathymetry and Training Structure Color Plates

Dear Mr. Palesh:

Thank you for providing color plates of the bathymetry and training structures, to be used in the Pool 5 Channel Management Plan, for review and comment. This letter contains comments from the Wisconsin Department of Natural Resources.

Overall, we believe your initial assessment of channel control structures has done an adequate job describing potential changes. However, many questions still remain, and many more will surface as your evaluations become more detailed.

Wing dams, closing dams and other rock structures add diversity to an already diverse system. However, the environmental benefits have been relatively unexplored, and therefore unknown. Fisheries surveys, conducted last September and October in Pool 5, showed seasonal variations as well as variations from structure to structure; fish assemblages are also quite different from one end of the structure to the other. Our surveys also showed that a partially sand shoaled structure, an area not highly regarded by some biologists, could provide quality habitat for certain fish.

Before structure modifications are proposed for environmental purpose, we believe current environmental benefits of structures need to be more fully explored. As we identify modifications, results of our actions must be fully realized. Caution must be taken when modifications are implemented; a slower approach, with evaluations as we proceed, may be prudent.

I hope these comments will be helpful with your further study of specific structure evaluation. We urge you to continue your evaluations and consider the effects of potential modifications. Please contact me at 608-685-6221 if you have any questions.

Sincerely,

Brian Brecka, Mississippi River Fisheries Biologist
Wisconsin Department of Natural Resources - Alma

c: Scot Johnson - Minnesota DNR, Lake City, MN
Bob Drieslein - USFWS, Winona, MN
Gretchen Benjamin - Wisconsin DNR, LaCrosse, WI

CEMVP-PE-M 12 February 1998

MEMORANDUM FOR RECORD

SUBJECT: Pool 5 Channel Management Study

1. A working coordination meeting for the subject study was held on 11 February 1998 at the offices of the Minnesota Department of Natural Resources in Lake City, Minnesota. The primary purpose of the meeting was to identify the channel control structures in pool 5 that would be focused upon during the remainder of the study. Attendees included:

Dennis Anderson	COE	Scott Goodfellow	COE
Scott Bates	USCG	Scot Johnson	MDNR
Brian Brecka	WDNR	Dan Krumholz	COE
Dan Dieterman	MDNR	Gary Palesh	COE
Bob Drieslein	FWS	Gary Wege	FWS

2. The resource management agencies were asked to review the environmental goals and objectives that are contained in the April 1997 Problem Appraisal Report to insure that they are still valid. Comments were requested in 30 days.

3. Prior to the review of specific structures, a brief review of other portions of the study was conducted.

a. Mosiman's Slough - Mosiman's Slough is an important overwintering area for backwater fish species. During the problem appraisal phase of the study it was identified that sedimentation in this slough may be changing flow patterns, resulting in a decline in the quality of the overwintering habitat. Brian Brecka and Dan Dieterman visited the site on 10 February and took dissolved oxygen, water temperature, and current velocity measurements. The values for all three parameters were good re:overwintering habitat criteria. After some discussion it was decided that no modifications at Mosiman's Slough are warranted at this time. The primary concern with a dynamic area such as Mosiman's Slough is that any modifications to improve habitat probably have an equal risk of causing undesirable habitat changes.

b. Willow Cat Slough - During the problem appraisal phase it was identified that sedimentation at times threatens to close off the mouth of this slough. During the summer of 1997 a sand bar was blocking about one-half the slough opening, but there was substantial flow entering the slough through the unblocked one-half. After some discussion it was decided that no modifications at Willow Cat Slough are warranted at this time. As with Mosiman's Slough, any modifications to control sand bar formation at the mouth of the slough probably have an equal risk of causing undesirable habitat changes.

c. Probst Lake - Probst Lake is an important overwintering area for backwater fish species. During the problem appraisal phase it was identified that a channel entering the lake from Belvidere Slough may be enlarging, resulting in too much flow entering the lake and degrading winter habitat conditions. A review of historic maps and aerial photographs indicates that this channel formed sometime post-lock and dam construction. During the period 1973 through the present, the mouth of the channel has enlarged from approximately 40 feet to 100 feet. Brian and Dan also visited Probst Lake on 10 February and took dissolved oxygen, water temperature, and current velocity measurements. The values for all three parameters were good re:overwintering habitat criteria. Of special note was that no flow appeared to be entering the lake via the channel. Based on their observations it was decided that measures to reduce that size of the channel opening did not appear necessary. We will develop a design to stabilize the mouth of the channel and prevent it from enlarging.

d. Lower Belvidere Slough - Over time there has been a loss of islands in lower pool 5 similar to what has occurred in many other navigation pools. As part of this study we will be evaluating the alternative of restoring islands in lower pool 5 using channel maintenance dredged material. If the UMRS-EMP is reauthorized, there may be an opportunity to use funds from that program to assist in island stabilization and revegetation. We currently are collecting bathymetric data for this area to be used to develop conceptual island restoration plans.

4. There are approximately 170 channel control structures in pool 5. Initial screening reduced the number of structures to be evaluated to less than 100. As noted earlier, the primary purpose of the meeting was to further screen the structures to identify those to be studied further. To facilitate the process, the pool was divided into 9 segments (A through I) as shown on the attached map.

a. Segment A - Head of the Pool to River Mile 750.0

No pressing navigation or channel maintenance concerns have been identified in this reach. Any structure modifications would be for fish and wildlife habitat purposes.

(1) Wiggle Waggle Slough - Sedimentation is a problem in the lower reaches of Wiggle Waggle Slough. For habitat purposes, it is desirable to maintain or increase the amount of flow down this slough. Wing dam 30 (RM 752.1 RB) appears to be the controlling structure for flow passing though Wiggle Waggle Slough. Notching wing dam 30 will be evaluated as a measure to increase flow through Wiggle Waggle Slough. Concerns noted that will have to be considered during the evaluation will be the effects on the new Wiggle Waggle Slough outlet near wing dam 29 (RM 752.3 RB) and the potential effects on the channel behind Lanes Island.

(2) Lanes Island Secondary Channel - There is a secondary channel passing behind Lanes Island. Closing dam 28 is located at the head of this secondary channel. Bathymetric data indicates high habitat diversity in this secondary channel. Therefore, it was decided that modification of closing dam 28 was unnecessary.

(3) Wing Dam 71 (RM 751.8 RB) - The main channel border habitat in the area of this wing dam consists primarily of shallow sand flats. It was decided that notching of this wing dam to increase local bathymetric diversity should be evaluated.

(4) Wing Dams 69, 70, and 72 (RM 751.2 RB) - The main channel border habitat in the area of these wing dams consists primarily of shallow sand flats. It was decided that notching of these wing dams to increase local bathymetric diversity should be evaluated. The effects on the adjacent small island remnant will need to be considered.

(5) Wing Dams 78 and 79 (RM 750.7 RB) - The main channel border habitat in the area of these wing dams consists primarily of shallow sand flats. It was decided that notching of these wing dams to increase local bathymetric diversity should be evaluated.

(6) Pine Island Secondary Channel - There is a secondary channel passing behind Pine Island. A number of wing dams cross this secondary channel, though many may be buried by sand. Bathymetric data indicates relative good habitat diversity in this secondary channel. It was decided that wing dam 18 at the head of the channel would be assessed to insure adequate flow is maintained in this secondary channel.

b. Segment B - Head of West Newton Chute

West Newton Chute is a major secondary channel with a deteriorated closing dam (CD 4) at the head. Available options are to (1) do nothing, (2) remove the structure, and (3) restore the structure, possibly to its original elevation. Option 2 is probably not feasible due to potential channel maintenance effects at the Mule Bend dredge cut, and expected opposition by private property owners on West Newton Chute due to bank erosion concerns (even though removal of the structure would likely have little or not effect on the bank erosion problem). A plan for restoration of the structure will be developed. A channel maintenance constraint with a restored structure is that the opening needs to remain navigable for barges transporting dredged material to the West Newton Chute dredged material placement site.

c. Segment C - Head of West Newton Chute to Head of Belvidere Slough

(1) Wing Dams 46 and 89 (RM749.3 LB) - The main channel border habitat in the area of these wing dams consists primarily of shallow sand flats. It was decided that notching of these wing dams to increase local bathymetric diversity should be evaluated.

(2) Wing Dam 97 and Closing Dam 11 (RM 748.9 LB) - Closing dam 11 crosses the opening to Mosiman's Slough and wing dam 97 ties into closing dam 11. There is a shallow sand flat below wing dam 97 that makes recreational boat access into Mosiman's Slough difficult. Modifications to closing dam 11 are not desired because of potential effects on Mosiman's Slough. We will evaluate whether or not a notch in wing dam 97 may reduce the sand shoaling below this wing dam to facilitate easier recreational boat access into Mosiman's Slough.

d. <u>Segment D - Head of Belvidere Slough</u>

Belvidere Slough is a major secondary channel that has a number of structures located at the head of the channel. As with West Newton Chute, available options are to (1) do nothing, (2) remove structures, and (3) restore structures. Option 2 is probably not feasible due to potential channel maintenance effects, and because some of the structures are small and inconsequential and likely buried by sand. Restoration evaluations will focus on wing dams 9 and 10 to prevent shifting of the navigation channel into the head of the slough.

e. <u>Segment E - Head of Belvidere Slough to Roebuck's Run</u>

This reach contains potential modifications for both channel maintenance and environmental purposes. The main channel border habitat in the area of the wing dams 83 and 84 (RM 746.7 RB) consists primarily of shallow sand flats and notching may improve local bathymetric diversity. There is also a channel maintenance problem in this area. Thus, wing dams 82, 83, and 84 will be evaluated for modification for both channel maintenance and habitat improvement purposes.

f. <u>Segment F - Roebuck's Run</u>

Roebuck's Run has been enlarging, diverting additional flow from the main channel. There are navigation and channel maintenance concerns with this situation. In addition, this is increasing sand transport into Roebuck's Run and eventually Belvidere Slough which is a concern to local recreational interests. The following alternatives will be evaluated for the head of Roebuck's Run, (1) do nothing, (2) armor the islands at the head of Roebuck's Run to prevent further enlargement, and (3) install a partial closure structure in Roebuck's Run (would include the armoring of the islands).

g. <u>Segment G - Roebuck's Run to Minnesota 14</u>

This reach contains a mixture of potential modifications for both channel maintenance and environmental purposes.

(1) <u>Sand Slough</u> - Sand Slough conveys flow and sand to Belvidere Slough and the upper reaches of Lost Island Lake. From a habitat perspective this is not considered a problem. This does make navigation between Sand Slough and Belvidere Slough by recreational craft difficult because of shifting channels. It does not appear that there is any structural modification that can be implemented that would rectify the recreational boat access problem without having substantial habitat effects. Therefore, Sand Slough will not be evaluated any further under this study. **The St. Paul District's Natural Resource Section proposes to stabilize the head of the right descending bank at Sand Slough during 1998 which may reduce the amount of sand entering Sand Slough (Randy Urich, pers. comm.).**

(2) Closing Dam 59 (RM 745.6 RB) - This closing dam is located behind Island 47. This area is also the outlet of Krueger Slough. This area is relatively shallow. It was decided to evaluate notching of closing dam 59 to improve local bathymetric diversity. The head of Island 47 has eroded back 400-500 feet since pre-lock and dam conditions. Restoration of Island 47 may have the same effect by narrowing the channel behind the island and increasing current velocities and associated scour.

(3) Wing Dams 56 and 98 (RM745.3 LB) - The main channel border habitat in the area of these wing dams consists primarily of shallow sand flats. It was decided that notching of these wing dams to increase local bathymetric diversity should be evaluated.

(4) Wing Dam 107 (RM 744.5 LB) - This wing dam is located immediately downstream of the upper opening to Lost Island Lake. There is a habitat concern associated with the amount of sand entering Lost Island Lake through this opening. Modification of this wing dam would likely have little or no effect on the amount of flow and associated sand entering the lake. Therefore, modification of this structure will not be evaluated further. **The St. Paul District Natural Resources Section proposes stabilizing the shoreline of the Lost Island placement site immediately above this opening as a work item (Randy Urich, pers. comm.).**

(5) Wing Dams 65 and 106 (RM743.3 RB) - The main channel border habitat in the area of these wing dams consists primarily of shallow sand flats. It was decided that notching of these wing dams to increase local bathymetric diversity should be evaluated.

(6) Wing Dams 52, 53, and 105 (RM 742.7) - These wing dams are located at Minneiska Bend, a difficult bend in the navigation channel. Extension of these wing dams will be evaluated as a measure to realign the channel slightly to make this bend less sharp.

h. Segment H - Minnesota 14 to River Mile 741.0

Increased dredging requirements are starting to occur at the lower end of this reach. However, it is too early to determine if this is the beginning of a long term problem that will increase in magnitude. At some time in the future, evaluation of wing dams 109, 59, and 1 at river mile 741.3 may be necessary. However, evaluation of these structures is not considered necessary at this time. No structural modifications for habitat purposes were identified for this reach.

I. Segment I - River Mile 741.0 to Lock and Dam 5

No navigation or channel maintenance concerns have been identified in this reach. Any structure modification would be for habitat purposes. Between river miles 738.9 and 740.4 on the right side of the navigation channel is a large wing dam field of 10-12 wing dams. Much of this area appears shallow and notching of these wing dams may create additional bathymetric diversity. Dan Dieterman indicated there is a relatively good aquatic plant bed in a portion of this area. Bathymetric data is lacking for a portion of this area and we are in the process of obtaining that data. It was decided to defer any decisions concerning this area until the bathymetric data becomes available.

5. A number of other miscellaneous items were discussed. The most noteworthy are as follows.

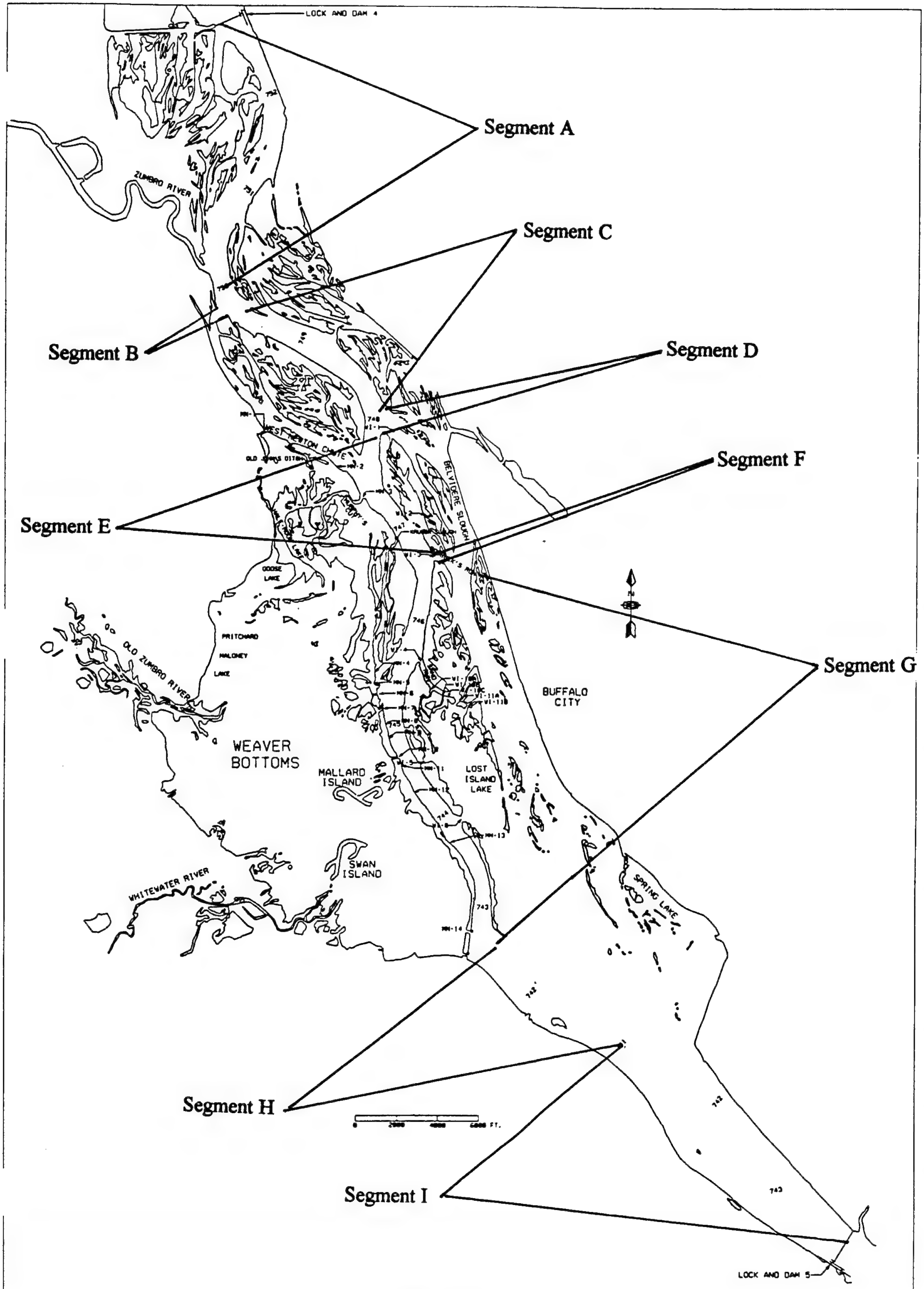
a. The question was asked whether or not we are still considering stabilizing the head of Island 40. We will develop a design to stabilize the head of this island.

b. There is a channel marker located at river mile 749.5 RB that is detached from the shore. The 1997 spring high water seems to have increase the gap between the marker and the shore. The question was asked whether this presented a problem that needed to be looked into as this marker is located immediately above the Island 42 control structure. No definitive answer could be provided at the meeting. **Subsequent to the meeting I discussed the situation with Don Powell (PE-M) re: the Island 42 control structure. He does not believe this presents a problem for the control structure now that the 1997 flood damage has been repaired and additional rock protection added. Thus, there appears to be no need to consider this situation any further under this study. The U.S. Coast Guard is responsible for the channel markers and will have to evaluate the stability of this structure within the parameters of their program.**

c. There was discussion concerning the capability of the hydraulic model being used for the study. The model is capable of showing flow distributions and velocity vectors on a large scale. However, the model is not capable of showing the localized changes associated with individual structure modifications such as wing dam notches or extensions of a wing dam.

Encl

Gary Palesh
Technical Manager


LOCK AND DAM 4
Segment A
ZUMBRO RIVER
Segment C
Segment B
Segment D
WEST NEWTON CHUTE
BELVIDERE SLOUGH
Segment F
Segment E
GOOSE LAKE
Segment G
PRITCHARD
MALONEY
LAKE
OLD ZUMBRO RIVER
BUFFALO CITY
WEAVER BOTTOMS
MALLARD ISLAND
LOST ISLAND LAKE
SWAN ISLAND
WHITEWATER RIVER
SPRING LAKE
Segment H
Segment I
LOCK AND DAM 5

CEMVP-PE-M 20 May 1998

MEMO FOR RECORD

SUBJECT: Pool 5 Channel Management Study

1. A coordination meeting for the subject study was held May 18 at the Fountain City Service Base, primarily for the purpose of discussing wing dam notching for habitat purposes. Meeting attendees included:

Dennis Anderson, COE	Scot Johnson, MDNR
Brian Brecka, WDNR	Dan Krumholz, COE
Dan Dieterman, MDNR	Gary Palesh, COE
Scott Goodfellow, COE	Gary Wege, USFWS

2. A series of wing dam modifications for habitat improvement purposes were discussed and decisions made concerning whether or not to go forward with these proposals.

(a) Wiggle Waggle Slough - Sedimentation is a problem in the lower reaches of Wiggle Waggle Slough. For habitat purposes, it was identified that it would be desirable to maintain or increase the amount of flow down this slough. Wing dam 30 (RM 752.1 RB) appeared to be the controlling structure for flow passing though Wiggle Waggle Slough and a proposal had been developed to notch wing dam 30 to maximize flow and scour in the downstream area of Wiggle Waggle Slough. However, a site visit by Dan Dieterman and Brian Brecka indicated that wing dam 76 crosses the historic outlet to Wiggle Waggle Slough. Wing dam 76 is probably the downstream control on the historic outlet and notching wing dam 30 would likely not provide any appreciable benefits in increasing flow down this channel. Resource agency biologists were not interested in notching wing dam 76 because of the relatively good habitat that exists above and below the structure.

Wiggle Waggle Slough has formed a new secondary outlet upstream of the historic outlet. Whether this new outlet will eventually become the primary outlet only time will tell. There was some discussion of plugging the new outlet to force additional flow down the historic outlet channel. This was not considered desirable from a habitat perspective.

It was decided not to pursue any wing dam modifications in this area. Any consideration of modifications to this area will be placed in a "deferred" status. At some point in the future the situation in this area will be reevaluated to determine if modification of the wing dams in this area is desirable for habitat restoration purposes.

(b) Wing Dam 71 (RM 751.8 RB) - The main channel border habitat in the area of this wing dam consists primarily of shallow sand flats. A notch to a depth of 652, with a 5-meter bottom width was proposed for this wing dam. Notching of this wing dam was supported by meeting participants. After some discussion, it was decided to locate the notch approximately 50

meters from the shoreline. The excavated material would be used to create a submerged trailing dam downstream of the wing dam along one side of the notch.

© Wing Dams 69, 70, and 72 (RM 751.2 RB) - It was determined that these wing dams should be notched to restore secondary channel habitat in front of Lanes Island. The wing dams would be notched to 6 feet below LCP (elevation 654). The wing dams would be notched fairly wide (30 meters) to maximize flow and scour throughout this secondary channel. The excavated material would be used to stabilize eroding shoreline along a small island remnant in the area.

(d) Wing Dams 78 and 79 (RM 750.7 RB) - The main channel border habitat in the area of these wing dams consists primarily of shallow sand flats. It was proposed to notch the wing dams to a depth of 652, with a 10-meter bottom width. A recent site visit by Dan Dieterman and Brian Brecka indicated the water depths in the area to be deeper and more diverse than shown by the bathymetry data. It was decided that notching of these wing dams was probably not necessary. A review of the bathymetry data will be conducted to determine if the map scale masked the true nature of the bathymetry in this area.

(e) Pine Island Secondary Channel - There is a secondary channel passing behind Pine Island. A number of wing and closing dams (WD 18, 16, & 14; CD 44) cross this secondary channel, though many may be buried by sand. Bathymetric data indicates some habitat diversity in this secondary channel. No recommendations for wing dam notching were developed. It was decided that any consideration of channel structure modifications in this location should be deferred.

(f) Wing Dams 46 and 89 (RM749.3 LB) - The main channel border habitat in the area of these wing dams consists primarily of shallow sand flats. Consideration was given to notching these wing dams to a depth of 652, with a 10- and 5-meter bottom width, respectively. Based on habitat conditions observed during an on-site inspection by Dan Dieterman and Brian Brecka, it was determined that notching of these wing dams was not necessary. They did identify that notching of wing dam 17 (RM 749.7 LB) located at short distance upstream would be beneficial in maintaining flows behind a small island along the left bank. After some discussion, it was decided to recommend notching of wing dam 17. The excavated material would be placed along the shore of the island for bank stabilization.

(g) Wing Dam 97 (RM 748.9 LB) - Consideration was given to notching wing dam 97 to try to reduce shoal formation at the upper entrance to Mosiman's Slough for recreational boat access purposes. It was determined that notching of closing dam 11 at this same location would probably be necessary to achieve any effect. Notching of closing dam 11 is not considered desirable because of the unknown effects on the Mosiman's Slough area. Therefore, it was decided not to notch wing dam 97.

(h) Closing Dam 59 (RM 745.6 RB) - This closing dam is located behind Island 47. This area connects to the outlet of Krueger Slough. From the new bathymetry for this area, one cannot easily discern the location of either CD 59 or the submerged riprap that used to armor the head of the island. WD 23, which is located immediately upstream of the inlet, is clearly evident

in the bathymetry. The area downstream of WD 23 is relatively shallow, including the relatively wide mouth of the inlet. If it can be found, notching CD 59 is not likely to change the existing habitat conditions much. The head of Island 47 has eroded back 400-500 feet since pre-lock and dam conditions. Island 47 was listed under the EMP bank stabilization project, but was deferred because of relatively cost per habitat unit ($4,500/AAHU). Because of the dynamic conditions in the area and the lack of a clearly defined habitat need, it was decided to defer any channel structure modifications at this site.

(I) Wing Dams 56 and 98 (RM745.3 LB) - The main channel border habitat in the area of these wing dams consists primarily of shallow sand flats. It was proposed to notch these wing dams to a depth of 652, with a 3-meter bottom width. The notches in WD 65 and 106 would be located approximately 30 and 40 meters from the shoreline, respectively. This proposal was endorsed by meeting attendees. The excavated rock/sand/willow would be placed along shoreline areas in the vicinity that are eroding or as rock mounds immediately below the notch.

(j) Wing Dams 65 and 106 (RM743.3 RB) - The main channel border habitat in the area of these wing dams consists primarily of shallow sand flats. The wing dams would be notched to a depth of 652, with a 3-meter bottom width. The notches in WD 65 and 106 would be located approximate 25 and 40 meters of the shoreline, respectively. This proposal was endorsed by meeting attendees. The excavated rock/sand/willow would be placed along shoreline areas in the vicinity that are eroding or as rock mounds immediately below the notch.

(I) Lower Pool Wing Dams - Between river miles 738.9 and 740.4 on the right side of the navigation channel is a large wing dam field of 10-12 wing dams. Much of the area inside of the wing dam field is shallow (< 1.7 meters) and Dan Dieterman indicated there is a relatively good aquatic plant bed in a portion of this area. This area could be a candidate for a long narrow barrier peninsula connected to the Minnesota Shoreline, with occasional openings. This idea was generally viewed positively, at least from a conceptual perspective. The Minnesota DNR representatives asked that we consider the potential for using seed islands in this area.

Generally, this area has decent bathymetric diversity, with a secondary channel connecting to the deep-water area along the Minnesota shoreline. The wing dams generally have 2.2 meters of water over them. To increase bathymetric diversity, 10 meter notches were proposed for wing dams 4, 29, 30, and 33. The bottom elevation of the notches would be at elevation 648. The excavated material would be mounded to an elevation 656 on the structure next to the notch. Another option to increase bathymetric diversity would be to not notch the structures, but place new rock in selected areas on the structure to bring these areas to elevation 656. Because of the existing deep water over the structures, increasing the elevation of selected areas may increase bathymetric diversity more than the notches. Cost will be a major factor affecting which option to pursue. The meeting attendees endorsed further consideration of these measures.

3. Willow Cat Slough - Sedimentation at times threatens to close off the mouth of this slough. During the summer of 1997 a sand bar was blocking about one-half the slough opening, but there was substantial flow entering the slough through the unblocked half. The mouth of the slough is now closed off by sedimentation. According to Dan Dieterman there was a significant winterkill,

including catfish, throughout the slough in late February of 1998. Dan indicated that some bank protection measures located upstream of the mouth of the slough appear to have failed and this may be the source of some the material blocking the mouth of the slough. Corps staff will conduct a site visit to review the situation. It is recognized by everyone that there is no easy solution to this problem.

4. Head of Island 40 - We distributed a GIS analysis showing the amount of erosion that has occurred at the head of this island during the period 1973-94. We indicated that we are developing a design for stabilizing the head of this island, but that the solution may be costly.

5. Head of West Newton Chute - We recounted the results of a meeting with local landowners held on May 12. We indicated that we would be evaluating measures that would stabilize the entrance to this major secondary channel at present conditions and measures that would reduce flow in the channel to some previous level. We asked that the resource management agencies begin to condsider the acceptability of some reduction in flow in West Newton Chute.

6. Head of Belvidere Slough - Scott Goodfellow presented an initial proposal to rebuild wing dam 9 and stabilize the head of Belvidere Island. The purpose would be to reduce the sharpness of the bend in the navigation channel at this point. The proposal was presented for information purposes, though we did ask the agency representatives to get back to us in the near future if they had any major concerns with the proposal.

7. Probst Lake - We indicated that we would be developing a design to stabilize the head of the channel that conveys flow from Belvidere Slough to Probst Lake.

8. Roebuck's Run - Scott Goodfellow present an initial proposal to stabilize the entrance to Roebuck's Run with bank stabilization and a channel liner. In addition, in this same location, wing dams 84 and 85 would be rebuilt to reducing a shoaling problem in the main channel. The proposal was presented for information purposes, though we did ask the agency representatives to get back to us in the near future if they had any major concerns with the proposal.

9. Minneiska Bend - We indicated that we would not be proposing any channel structure modifications in the Minneiska Bend area until such time as the effects of the modifications to the Weaver Bottoms outlet structure (Minnesota 14) can be evaluated.

10. Island Restoration - We are in the process of developing a conceptual island restoration plan for the lower reaches of the pool which we will distribute to the resource management agencies for review.

Gary Palesh
Technical Manager

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Upper Mississippi River National Wildlife and Fish Refuge
Winona District
51 E. Fourth Street - Room 203
Winona, Minnesota 55987

IN REPLY REFER TO:

July 17, 1998

JUL 20 1998

Mr. Dean Peterson
U.S. Army, Corps of Engineers
Mississippi River Project Office
Fountain City, WI 54629

Dear Mr. Peterson:

This is to bring to your attention what we feel is a serious sedimentation problem in the area of Navigation Pool 5 known as "Murphy's Cut."

This matter was reported to me by Bob Wallace, DNR Conservation Warden at Plainview, Minnesota. He had received complaints from area boaters and anglers having difficulty negotiating the cut south and east of the Halfmoon boat landing (see map 1). Wallace and I checked this area by boat on July 14, 1998 and found water depths in the two to two and one-half foot range in the area colored in on the attached map. At one place we had to raise the motor and pole across a shallow sand flat. Bob called me on 7/15/98 and reported that Pool 5 had dropped about 4 inches in 24 hours and that the cut between Halfmoon Landing and Murphy's Cut structure was now impassable by boat.

In 1990, the Corps of Engineers made a dredge cut in this same area removing about 2,500 yards of sand. At that time it was thought (hoped) that this was sand that had bypassed the Murphy's Cut structure during flooding while it was under construction in the fall of 1986.

Considerable sand deposition is also occurring at the mouth of Murphy's Cut where it joins the main navigation channel. Water depths across the entire mouth of the cut at this point varied from two to two and one-half feet. These shallow depths are not the result of unusually low water levels. The Pool 5 river stage at Alma on 7/15/98 was 660.77 which according to Jon Hendrickson is about normal for this time of year. Based on the situation I described, Jon feels that bedload is probably entering Murphy's Cut, passing through the rock partial closure and settling out in the sloughs below Halfmoon landing.

Dean, at the rate this is going, the Halfmoon boat landing may soon be unusable for recreational boats. Further, sand deposits may be blocking fish movement in Murphy's Cut and seriously impacting valuable waterfowl habitat as this material works its way into Halfmoon Lake and the upper reaches of Weaver Bottoms. The Service is asking that the Corps take a look at the situation in Murphy's Cut to determine what might be done to offset the negative processes that

are underway as regards sand movement into the backwaters.

Mr. Wallace suggested some type of rock closing structure or deflecting dam across the entrance to Murphy's Cut as a means of diverting bedload downstream. With the Pool 5 Channel Maintenance Plan project currently underway, this could be an opportune time to address the problem.

Your help and assistance in addressing this situation would be most appreciated, and if you wish to discuss the matter further, please give me a call.

Sincerely,

Robert L. Drieslein

Robert L. Drieslein
District Manager

cc: Eric Nelson, Weaver Bottoms Task Force, Winona, MN
Bob Wallace, MN DNR, Plainview, MN
Tim Schlagenhaft, MN DNR, Lake City, MN
Jon Hendrickson, US COE, St. Paul, MN

CEMVP-PE-M 16 September 1998

MEMORANDUM FOR RECORD

SUBJECT: Pool 5 Channel Management Study

1. A coordination meeting for the subject study was held at the Fountain City Service Base on 14 September 1998. Meeting attendees were:

Dennis Anderson, COE	Dan Krumholz, COE
Tony Batya, USFWS	Judy Mader, MPCA
Gretchen Benjamin, WDNR	John Murren, USCG
Brian Brecka, WDNR	Gary Palesh, COE
Scott Goodfellow, COE	Gary Wege, USFWS
Scot Johnson, MDNR	

2. A copy of the meeting agenda is attached. The following discussions took place concerning the specific agenda items.

a. Summary of Previous Decisions - Previous decisions made during the study were reviewed, primarily the plan to notch 13 wing dams fish habitat enhancement purposes. The only comment was from the Minnesota DNR in that when applying for permits, we would need to show the locations where the excavated material from the wing dams would be placed. I indicated that due to the small quantities involved, we probably would not show the proposed locations in the Definite Project Report (DPR), but there would be a narrative description of the location. I also indicated that the final recommendation concerning placement sites will likely be made in the field by the On-Site Inspection Team (OSIT).

b. Head of Belvidere Slough/Probst Lake - The proposed design to rehabilitate wing dam 9 and place bank stabilization on the head of Belvidere Island was discussed. It was pointed out that stabilizing the entrance channel to Probst Lake (environmental objective) could be accomplished as part of the bank stabilization. No site specific concerns with these features were identified.

Scot Johnson questioned why we were pursuing these features because the concern with the migration of navigation channel in this location was not an objective identified in the April 1997 Problem Appraisal Report (PAR). I responded that we would not ignore problems that surfaced subsequent to the completion of the PAR, regardless of whether they were navigation safety, environmental, or of some other nature. (As an aside, reducing or eliminating navigation safety hazards is a study goal identified in the April 1997 PAR).

The Minnesota DNR questioned whether this proposal would affect sedimentation in lower Belvidere Slough. It would not. Minnesota and Wisconsin DNR representatives expressed concern that this project continues to "harden" the main channel in its current location. The

District view is that this structure presently exists and rehabilitation would not be an appreciable change from the existing condition relative to the main channel being constrained by navigation structures. This will be addressed in the DPR.

c. Roebuck's Run Area - The proposed designs to stabilize the entrance to Roebuck's Run and extend wing dams 84 and 85 were discussed. No concerns were expressed concerning the proposed design for Roebucks's Run. As an aside, stabilization of Roebuck's Run is also a recommendation of the Weaver Bottoms Task Force.

The Minnesota and Wisconsin DNR representatives questioned the need to extend wing dams 84 and 85. Scott Goodfellow indicated that this is a wide area in the main channel with a deep point bar. Extending the wing dams will concentrate flows to maintain a channel deep enough for navigation through this area. The primary purpose is reduce the frequency of marginal channel conditions and imminent closures in this location. A reduction in dredging requirements may also be realized at this location, although perhaps not pool wide.

d. Head of West Newton Chute - A design was developed that would prevent West Newton Chute from widening (bank stabilization) and to reduce the amount of flow entering West Newton Chute (closing dam restoration). The purpose was to determine if these actions would be cost effective in reducing channel maintenance requirements at the Mule Bend and West Newton dredge cuts.

The Minnesota DNR expressed concern with these features over the amount of littoral habitat that would be converted to rock substrate and that reducing flows in West Newton Chute would increase sedimentation in the lower reaches of the chute.

e. Head of Island 40 - A design was developed to control erosion at the head of Island 40. The solution (rock bank stabilization) would cost in excess of $600,000. The District analysis is that the habitat benefits (preserving island habitat) would not justify the cost. This conclusion was not disputed by anyone in attendance.

f. Willowcat Slough - Willowcat Slough has a sedimentation problem at its entrance and this past winter suffered a winterkill. It is not known if the sedimentation problem contributed to the winterkill due to other factors. The District has been unable to identify any structural modification that would solve the sedimentation problem. Possible options that may be worth pursuing include dredging the sand bar at the mouth of the slough, conducting further study of flow patterns in Willowcat Slough in conjunction with the operation of the gated culvert at the Island 42 EMP habitat project, and possible removal of snags/fallen trees that may be affecting flow through the slough. No conclusion was reached. The resource management agencies responsible for the Island 42/Willowcat Slough complex (U.S. Fish and Wildlife Service and Minnesota DNR) will need to take the lead relative to any further action.

g. Half Moon Landing/Murphy's Cut - Sedimentation at the mouth of and within Murphy's Cut is affecting boat access from Half Moon Landing to the main channel. The reason for the sedimentation and potential solutions were discussed. It is the view of Scott Goodfellow

that eventually a relatively defined channel will form through the sand bar at the entrance to Murphy's Cut.

For the interior sand bar, the best course of action may be to excavate a channel to assist the formation of a natural channel through this sand bar. The U.S. Fish and Wildlife Service will collect data relative to flow distributions in this area. From this data, District will develop a recommended channel design. Implementation will likely be the responsiblity of the U.S. Fish and Wildlife Service.

h. Island Restoration - Island restoration using channel maintenance material is a viable option in lower pool 5 because it would serve dual purposes. Island restoration would increase habitat diversity in this portion of the pool. Using channel maintenance material in island construction would potentially provide channel maintenance savings. The District developed a conceptual island restoration plan for all of lower pool 5 involving 15 islands. Screening of these potential islands identified two that were the best candidates for an initial test of construction using channel maintenance material, Island E and Island J. The relative merits were discussed, with no clear choice identified. The Wisconsin DNR will provide a recommendation to the District. If the Wisconsin DNR has no clear preference for either island, than the District will select one based primarily on implementation factors such as access for equipment.

Construction of an island using direct placement of channel maintenance material will likely take 7 to 10 years based on annual dredging requirements. This presents challenges relative to the implementation of stabilization features such as rock protection and topsoil. An option was discussed whereby a new containment facility would be constructed in lower pool 5. When sufficient material has been placed in the containment facility, an island would be constructed. The U.S. Fish and Wildlife Service appeared willing to consider this option further. However, the general reaction of the Minnesota and Wisconsin DNR representatives was negative.

3. The next step in the study will be for the District to further develop designs, especially for an island constructed with channel maintenance material, and to prepare a draft DPR.

Encl

Gary Palesh
Technical Manager

POOL 5 CHANNEL MANAGEMENT STUDY
September 14, 1998

AGENDA

1. Introductions

2. Summary of Previous Decisions

3. Head of Belvidere Slough/Probst Lake

4. Roebuck's Run Area

5. Head of West Newton Chute

6. Head of Island 40

7. Willowcat Slough

8. Half Moon Landing/Murphy's Cut

9. Island Construction

10. Future Activity

Palesh, Gary D MVP

From: BenjaG@mail01.dnr.state.wi.us
Sent: Monday, November 02, 1998 2:31 PM
To: JanvrJ@mail01.dnr.state.wi.us; BenjaR@mail01.dnr.state.wi.us; MoeT@mail01.dnr.state.wi.us; SulliJ@dnr.state.wi.us; WetzeJ@dnr.state.wi.us;
Subject: lower Pool 5 island meeting minutes from 10/27/98SCONS+3Bo=DNR+20WESTCENTRAL+3I

Hello,

John Wetzel wrote a note to the file and I decided we should all have the notes. Here they are, a mixture of John's notes and my notes.

Let me know if you have any comments. I will send these notes to Brian Brecka and Scot Johnson (MDNR).

Memorandum

November 2, 1998

On October 27, 1998, Gary Palesh (USACE), Dan Wilcox (USACE), John Wetzel (WDNR), Ron Benjamin (WDNR), Jeff Janvrin (WDNR) and myself, Gretchen Benjamin (WDNR) met to discuss channel maintenance island construction in lower Pool 5. (This is part of the planning process for the Channel Management Plan for Pool 5.)

Gary Palesh presented information about island construction for the lower portion of the pool and after some discussion the following conclusions were drawn.

(John Wetzel's notes)

It was generally decided that some attempt at using channel maintenance "sand" to construct a habitat island should be tried someplace and perhaps lower Pool 5 would be a good site.

It was basically agreed, however, that to start a one time smaller disposal island that would be riprapped, overlain with fines and seeded within approximately one year would be preferable to a bigger island that would not be finished for 7-10 years. It may also be possible to locate 2-3 locations for such smaller islands. (They may also be in such a formation that they could act as a larger island.) One potential use for a smaller island would be a nesting island.

(Gretchen Benjamin's notes)

It was also generally agreed that larger quantities of dredged material would be used to create small islands. If area dredging was less than 20,000 cy the material would go to Lost Island containment site. A dredging event between 20,000 and 30,000 cy would be determine as to whether or not it should used for island construction or placed in Lost Island Containment site. Dredging events over 30,000 cy would be the most desirable for island construction so events in this category would be used for island construction.

(John Wetzel's notes)

As follow up to the meeting Jeff Janvrin will send Gary Palesh the design of the nesting islands that were designed for Pool 8 below Goose Island. We will check lower Pool 5 and identify one or more sites that would be acceptable for nesting islands. (ie meet model criteria.)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Twin Cities Field Office
4101 East 80th Street
Bloomington, Minnesota 55425-1665

NOV 2 1998

Mr. Robert J. Whiting
Chief, Environmental Resources Section
Management and Evaluation Branch
St. Paul District, U.S. Army Corps of Engineers
Army Corps of Engineers Centre
190 Fifth Street East
St. Paul, Minnesota 55101-1638

Dear Mr. Whiting:

This concerns your October 22, 1998, letter requesting U.S. Fish and Wildlife Service (Service) comments on potential impacts to federally endangered or threatened species from implementation of the Channel Management Plan for Pool 5 of the Upper Mississippi River.

Based on information contained in your above referenced letter and the nature of the proposed projects, their location, and the habitat requirements of the federally threatened bald eagle (Haliaeetus leucocephalus) and endangered Higgins' eye pearly mussel (Lampsilis higginsi), we concur with your determination that the proposed projects are not likely to adversely affect federally listed threatened or endangered species. Should these projects be modified or new information indicates that listed species may be affected, consultation with this office should be reinitiated.

These comments have been prepared under the authority of and in accordance with provisions of the Endangered Species Act of 1973, as amended. Comments with respect to the Fish and Wildlife Coordination Act will be provided at the appropriate stage of planning. We appreciate the opportunity to offer our comments on this project.

Sincerely,

Lynn M. Lewis

Lynn M. Lewis
Field Supervisor

cc: Wisconsin Department of Natural Resources, LaCrosse, Wisconsin
Minnesota Department of Natural Resources, St. Paul, Minnesota

Pool 5 Channel Management Study
Meeting Attendees - December 15, 1998

Dennis Anderson, Corps of Engineers
Gretchen Benjamin, Wisconsin Dept. of Natural Resources
Brian Brecka, Wisconsin Dept. of Natural Resources
Bob Drieslein, U.S. Fish and Wildlife Service
Scott Goodfellow, Corps of Engineers
Jeff Janvrin, Wisconsin Dept. of Natural Resources
Scot Johnson, Minnesota Dept. of Natural Resources
Dan Krumholz, Corps of Engineers
Paul Machajewski, Corps of Engineers
Judy Mader, Minnesota Pollution Control Agency
Gary Palesh, Corps of Engineers
Gary Wege, U.S. Fish and Wildlife Service

CEMVP-PM-A 17 December 1998

MEMO FOR: See Distribution

SUBJECT: Pool 5 Channel Management Study - Small Island Cluster

1. Attached are maps showing a proposed small island cluster in the "B" and "E" island areas of lower Belvidere Slough. Please take a look at this layout and provide any suggestions you may have (as the layout is a combination effort of the renowned design firm of Goodfellow, Anderson, and Palesh, I personally don't see how it can be improved upon).

2. For island height, we recommend using an elevation range of 662.0 to 663.0 for the sand berms on the perimeter of the islands, with an island top elevation between 663.5 and 664.5. The following shows the elevations of flood events in lower pool 5:

normal pool (0 to 28,000 cfs)	660.0 to 659.5
normal pool (28,000 cfs to 116,000 cfs)	659.5
5-year (122,000 cfs)	660.1
10-year (150,000 cfs)	662.2
50-year (213,000 cfs)	666.0

We do not want to go below 662.0 with the sand berms as the island should be at least 2 feet above normal pool.

3. We recommend an island footprint width between 31m (100 ft) and 43 m (140 ft). Thus, once the island centerline is laid out, we would have about 20 feet of flexibility on each side of the island during construction. As a matter of information, the Pool 8 Islands Phase II islands at Stoddard range in size from 31m wide to 43m wide.

4. The following are rough estimates of sand quantities for the islands. The smaller quantities are for the lowest and narrowest island dimensions (using the above ranges), while the largest quantities are for highest and widest island. A change in width affects quantities more than a change in height.

Island B1	19,000 to 32,000 m3	or	25,000 to 41,000 cy
Island B2	18,000 to 28,000 m3	or	22,000 to 37,000 cy
Island E1	27,000 to 45,000 m3	or	36,000 to 60,000 cy
Island E2	15,000 to 25,000 m3	or	20,000 to 33,000 cy
Island E3	20,000 to 33,000 m3	or	26,000 to 43,000 cy

5. The following are the dredging quantities for the dredge cuts in lower pool 5 since 1990. Our target dredge cut is the Minneiska cut. However, I included info for the Lower Zumbro cut as the proposed island cluster is within reach of the lower end of that dredge cut. Material from the Lower Zumbro cut could be used to complete an island if there wasn't quite enough material in the Minneiska cut to do the job.

Year	Minneiska	Lower Zumbro	Total
1990	3,200 cy	0	3,200 cy
1991	34,100 cy	0	34,100 cy
1992	20,800 cy	23,700 cy	44,500 cy
1993	15,900 cy	56,700 cy	72,600 cy
1994	13,700 cy	0	13,700 cy
1995	25,000 cy	34,800 cy	59,800 cy
1996	43,400 cy	42,200 cy	85,600 cy
1997	0	28,100 cy	28,100 cy
1998	0	0	0

The Minneiska dredge cut would have had sufficient material to construct any island (except E1) in 3 of the 9 years (1991, 1995, 1996). In two other years (1992, 1993) there would have been sufficient material available from the Lower Zumbro dredge cut to finish off any island. Based on this short period of record, it appears there is about a 50-50 chance in any given year that there would be sufficient dredging required in Minneiska-Lower Zumbro area to construct any of the islands.

6. I would appreciate any comments you may have by January 5, 1999. If you have any questions, please call or E-mail me.

Encl

Gary Palesh
Project Manager

Distribution:
Bob Drieslein, USFWS
Gary Wege, USFWS
Gretchen Benjamin, WDNR
Brian Brecka, WDNR
Scott Johnson, MDNR
Dan Dieterman, MDNR
Judy Mader, MPCA
Dan Krumholz, COE
Scott Goodfellow, COE
Dennis Anderson, COE

MINNESOTA HISTORICAL SOCIETY

March 18, 1999

Ms. Sissel Johannessen
U.S. Army Corps of Engineers
190 5th Street East
St. Paul, MN 55101-1638

Re: Channel Management Project for Pool 5 of the Mississippi River
Wabasha County
SHPO Number: 99-1585

Dear Ms. Johannessen:

Thank you for the opportunity to review and comment on the above project. It has been reviewed pursuant to the responsibilities given the State Historic Preservation Officer by the National Historic Preservation Act of 1966 and the Procedures of the Advisory Council on Historic Preservation (36CFR800).

We concur with your analysis of archaeological impacts, and note that any upland areas to be affected will be surveyed.

We recognize the challenges involved in evaluating the wing dams for National Register eligibility. Many other types of resources that were built in large numbers present similar questions. You letter suggests an approach to mitigation for the effects on these dams. However, it seems to us that it is premature to discuss a mitigation strategy before we have an agreed-upon strategy for the identification and evaluation of the dams. We would be happy to meet to discuss this issue with you.

Contact us at 651-296-5462 with questions or concerns.

Sincerely,

Dennis A. Gimmestad
Government Programs & Compliance Officer

State Historical Society of Wisconsin
816 State Street ♦ Madison, Wisconsin 53706-1488 ♦ 608/264-6400 ♦ Fax: 264-6504

Division of Historic Preservation
608/264-6500

March 22, 1999

Mr. Robert J. Whiting
U.S. Army Corps of Engineers
Army Corps of Engineers Centre
190 Fifth Street East
St. Paul, MN 55101-1638

IN REPLY PLEASE REFER TO
SHSW COMPLIANCE CASE #99-0161/BF

RE: Channel Management Project For Pool 5 Of The Mississippi River

Dear Mr. Whiting:

We have reviewed the above-referenced project as required for compliance with Section 106 of the National Historic Preservation Act and 36 CFR 800: Protection of Historic Properties, the regulations of the Advisory Council on Historic Preservation governing the Section 106 review process.

There are no known archeological sites in the project area, and based on the nature and scope of the project, we do not believe an archeological survey is warranted. However, due to the prehistoric and historic maritime use of the area, it is possible that submerged resources are present. We are not aware of any shipwrecks in your project area, although several are reported in the immediate vicinity.

Should any archeological materials, including submerged features, artifacts, or structural material be encountered, construction or dredging activities should be halted. Please report the discovery immediately to the State Underwater Archeologist at (608) 264-6493. In addition, should any human remains be discovered during construction, you must contact our office for compliance with Wis. Stats. §157.70 (1991), which provides for the protection of burial sites.

The project as described in your correspondence will not affect any <u>structures</u> that are listed in, or known to be eligible for inclusion in, the National Register of Historic Places.

We remind you that 36 CFR 800.4 includes the requirement that you seek information, as appropriate to the undertaking, from parties likely to have knowledge of, or concerns with historic properties in the project area - such as Indian tribes, local governments, and public and private organizations.

If there are any questions concerning this matter, please contact Dan Duchrow at (608) 264-6505.

Sincerely,

Chip Harry L. Brown III, J.D.
Compliance Coordinator

CHLB/DJD/djd

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

REPLY TO
ATTENTION OF

APR 13 1999

Project Management Branch
Planning, Programs, and Project Management Division

Dear Interested Parties:

Enclosed for your information, review, and comment is the draft Definite Project Report/Environmental Assessment for the Pool 5 Channel Management Study, Upper Mississippi River. The report contains an integrated environmental assessment and draft Finding of No Significant Impact (FONSI). We are distributing this report to concerned agencies, local units of government, interested groups, and individuals. If you have any comments on the report or environmental assessment, please provide them within 30 days of the date of this letter.

Questions concerning the Pool 5 Channel Management Study should be directed to Mr. Gary Palesh, Project Manager, at (651) 290-5282 or at gary.d.palesh@mvp02.usace.army.mil. Please address all correspondence to the St. Paul District, Corps of Engineers, ATTN: CEMVP-PM-A, 190 Fifth Street East, St. Paul, Minnesota 55101-1638.

Sincerely,

Charles E. Crist

Charles E. Crist
Deputy for Programs and
Project Management

Enclosure

DEPARTMENT OF THE ARMY

ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

REPLY TO ATTENTION OF

APR 12 1999

Project Management Branch
Planning, Programs, and Project Management Division

Dear Interested Parties:

This is to inform you that the draft Definite Project Report/Environmental Assessment for the Pool 5 Channel Management Study has been completed and is available for public review. The report contains an integrated environmental assessment and draft Finding of No Significant Impact (FONSI). The executive summary for the report is attached.

A copy of the draft Definite Project Report/Environmental Assessment for the Pool 5 Channel Management Study can be obtained by contacting Mr. Gary Palesh, Project Manager, at (651) 290-5282 or at gary.d.palesh@mvp02.usace.army.mil. Please address all correspondence to the St. Paul District, Corps of Engineers, ATTN: CEMVP-PM-A, 190 Fifth Street East, St. Paul, Minnesota 55101-1638.

Sincerely,

Charles E. Crist

Charles E. Crist
Deputy for Programs and
Project Management

Minnesota Department of Natural Resources

Lake City Area Office
1801 South Oak Street
Lake City, Minnesota 55041

612/345-5601

May 13, 1999

Mr. Gary Palesh, Technical Manager
U.S. Army Corps of Engineers, St. Paul District
190 Fifth Street East
St. Paul, Minnesota 55101-1638

Dear Mr. Palesh:

Re: Pool 5 Channel Management Plan - draft Definite Project Report

The Lake City Area Office has completed its review of the draft Definite Project Report for the Pool 5 Channel Management Plan. The Lake City Area Office staff have an over-riding concern that the Channel Management Planning process results in a systematic hardening of the river geomorphic template and a reduction in the long-term structural dynamics necessary for a healthy, self-sustaining large floodplain river ecosystem.

It is our recommendation that the Corps postpone the extension and reconstruction of wing dam 84 and 85 until the Roebuck's Run partial closing structure effects on sediment transport are fully monitored and evaluated. As you are aware, the main channel's sediment transport efficiency was greatly enhanced by the Weaver Bottoms project. Maintenance dredging is now required further downstream beyond the endorsed Channel Maintenance Management Plan's dredge material containment sites. The extension and reconstruction of wing dams 84 and 85 would likely aggravate this problem. In addition, the rock fill and sediment deposition caused by the reduced velocities associated with the wing dam extensions would require wetland mitigation/compensation.

The Lake City Area Office offer the following additional comments for consideration:

<u>Executive Summary</u>

Paragraph 1. Channel training structures can be designed to avoid and/or minimize adverse effects to river natural resources attributable to these structures. Unavoidable adverse effects caused by the modification of channel training structures beyond their original dimensions and the construction of new structures will require mitigation/compensation.

2 The overall decline in habitat diversity and quality is attributable to the navigation channel's impoundment and associated channel training structures. The loss in habitat diversity and quality is reflected in the loss of islands, sedimentation in backwaters, a decline in aquatic vegetation and a reduction in bathymetric diversity.

3 The Weaver Bottoms Task Force identified water level management as its top priority management tool. The Executive Summary should highlight the Task Force's recommendations and how the CMP does or does not address them.

4 1.5.13. The recreational boating studies were also completed in 1997.

5 3.3. Please Add f) loss of islands.

6 4.4.1.1. In the last paragraph it is stated that hydrodynamic connectivity will increase with time as new secondary channels form. Please Add: However, as evident by the CMP planning process, the Corps is intent on limiting the number, location and size of any secondary channels which may reduce the sediment transport efficiency of the main channel. Changes to text within this DPR may be required in additional sections to address this comment.

7 4.4.1.2. It is still unclear to us how Simon's 1979 one-dimensional model could possibly predict a future river scene.

8 4.4.4. Riverine mussel species evolved under fluctuating water conditions. There is no research to support the statement that stable water levels are advantageous to mussels and this sentence should be removed.

9 5.2.8 . Wind-generated waves facilitated by the 9-Foot Channel Project impoundments are responsible for the erosion and loss of island habitat in the Upper Mississippi River.

10 6.4.2.7 Sediment has occluded the lower end of Krueger Slough too.

11 Section 8 This section seems to be out of place and could possibly be incorporated into Section 9 of the DPR.

12 9.2.1 Costs are approximately $72,000 not $67,000.

13 9.2.3 At one point in our discussion it was mentioned that Old John's Ditch was once the main inlet to Upper Weaver. The West Newton Colony's causeway has blocked flow for many years. A possible alternative solution may be the introduction of flow back through Old John's ditch.

14 9.2.6.1. See Section 6.4.2.7. for a specific habitat objective.

15 9.3.2.2. The CMMP estimates that 292,000 cubic yards, **not** 1,800,000 cubic yards, may be Pool 5 earmarked for island building within Weaver Bottoms. Considerable environmental and engineering review would be required by DNR Waters before a new permit could be issued for the construction of additional islands in Weaver Bottoms. Changes to text within this DPR may be required in additional sections to address this comment.

16 Summary The loss of islands attributed to erosion is merely a symptom of a river system forced to adapt to a major change in its hydrologic setting. The 9-Foot Channel Project impoundment is the cause for the loss of islands through erosion, subsidence and submersion resulting in the degradation of aquatic habitat.

Thank you for the opportunity to comment. Please call if you have questions or concerns regarding our comments or recommendations.

Sincerely,

Scot Johnson
Mississippi River Hydrologist

cc. Jim Cooper, Waters, Rochester
Bill Huber, Waters, Lake City
Tim Schlagenhaft, Fisheries, Lake City
Dan Dieterman, Fisheries, Lake City
Mike Davis, Eco Services, Lake City
Nick Gulden, Wildlife, Winona
Walt Popp, Eco Services, Lake City
Steve Johnson, Waters, St. Paul

June 4, 1999

Project Management Branch
Planning, Programs and Project Management Division

Mr. Scot Johnson
Minnesota Department of Natural Resources
1801 South Oak Street
Lake City, Minnesota 55041

Dear Mr. Johnson:

This is in response to your May 13, 1999, letter of comment on the draft Definite Project Report/Environmental Assessment for the Pool 5 Channel Management Study.

With regard to the concern expressed with the results of the channel management planning process, we can only respond that study results are a reflection of study goals and objectives, and the alternatives identified for evaluation. All of the study participants, including the Minnesota Department of Natural Resources, provide input to the development of the goals and objectives and identified alternatives for evaluation. Because the St. Paul District is studying the management of the navigation channel, we will be evaluating measures to reduce channel maintenance requirements and to reduce navigation problems, both of which will generally require structural solutions.

The recommended features resulting from this study benefiting channel maintenance and/or navigation involve the modification of 3 of the 170 existing channel structures in pool 5, stabilizing the head of Island 42, and stabilizing the entrance to Roebuck's Run (which also had a habitat purpose). We would not characterize this as a "systemic hardening of the river geomorphic template."

The Pool 5 Channel Management Study did not result in any recommendations that would "deharden" the river. In those locations where structural modifications of this nature were considered, such as at the outlet to Wiggle Waggle Slough and the upstream entrance to Mosiman's Slough, natural resource agency biologists were reluctant to recommend any action for fear that removal or notching of the structures would result in unanticipated habitat degradation. It should also be noted that the natural resource agencies participating in the study did not identify any wing dams for removal, and were cautious in

recommending wing dam notchings for fish habitat enhancement. This indicates to us that, for the most part, resource agency fishery biologists recognize that submerged channel control structures provide substantial fish habitat benefits in today's modified river system.

The purpose of the Roebuck's Run stabilization from a channel maintenance/navigation perspective is to prevent the existing condition from worsening by preventing the further loss of flow to the Belvidere Slough area, to reduce potential increases in channel maintenance requirements, and to reduce potential increases in outdraft problems. In addition, this feature will accommodate the recommendations of the Weaver Bottoms Resource Analysis Program. The primary purpose of the wing dam 84 and 85 modifications is to improve existing channel conditions by narrowing and deepening the navigation channel to reduce the frequency of shoaling and marginal channel conditions in this area. This is a relatively localized change, and any increases in downstream dredging requirements are expected to occur at the Lower Zumbro dredge cut, and even those should be relatively minor. We do not expect the effects of these minor modifications to be translated into increased dredging requirements in the Minneiska-Mount Vernon Light area of the lower pool. Therefore, we see no need from a channel management perspective to delay the construction of wing dams 84 and 85.

We do not concur that the rock fill associated with the modification of wing dams 84 and 85 and associated channel bed changes requires wetland mitigation/compensation. The area being affected is main channel/main channel border habitat that will not be converted to non-aquatic habitat. The habitat changes associated with the proposed wing dam modifications will be a scouring of the main channel and possibly some sediment deposition on the downstream side of the structures within the main channel border. We do not believe these localized bathymetry changes are of a significance that warrants compensatory mitigation. In addition, we believe the expected habitat improvements associated with the proposed notching of 14 wing dams will more than compensate for any adverse habitat effects that may result from modification of wing dams 84 and 85.

Responses to your specific comments are enclosed. We appreciate the time and effort your Department has contributed to this study. If you have any questions, please contact me at (651) 290-5282 or at gary.d.palesh@mvp02.usace.army.mil.

Sincerely,

/S/

Enclosure

Gary Palesh
Project Manager

Responses to Minnesota Department of Natural Resources Comments on the Draft DPR/EA for the Pool 5 Channel Management Study

1. Comment noted. The St. Paul District will mitigate for unavoidable adverse effects if the effects are of a nature or magnitude requiring mitigation. None of the features recommended as a result of this study would appear to have unavoidable adverse effects requiring mitigation.

2. Comment noted. We are working with a river system altered by the navigation project. That is the baseline condition, and as part of the channel management study process we are addressing some of the habitat problems associated with the existing condition. Indeed, islands have eroded because of the physical processes associated with impoundment, and we are trying to either slow or reverse this trend where possible. Rehashing the construction of the navigation project and its effects on the riverine system within the context of the channel management study process is valueless, as it will not alter the presence of the navigation project.

3. Narrative to that effect has been added to the executive summary.

4. The referenced section has been corrected.

5. The loss of islands has been added to the referenced section.

6. Do not concur. The comment is an unsupportable conclusion.

7. As stated in the text, the one-dimensional model was **one** of the tools Chen and Simons used in making their predictions. It was not the only tool.

8. The referenced statement has been removed.

9. Comment noted. The changes brought by impoundment are discussed in Sections 3 and 4 of the report, and it is not necessary to repeat them in the referenced section.

10. The referenced section has been modified to reflect this.

11. Comment noted. We do not want to reformat the report at this late stage of study. This comment will be considered in the formatting of the report for the next channel management study.

12. This has been corrected.

13. The narrative in the referenced section has been revised to discuss this item.

14. The narrative in the referenced section has been revised.

15. The referenced section made no mention of cubic yards of material to be used in the construction of additional islands in Weaver Bottoms. The discussion has been modified to clarify that we are talking about the 292,000 cubic yards identified in the Channel Maintenance Management Plan.

16. See response to comment 2.

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

WISCONSIN
DEPT. OF NATURAL RESOURCES

Tommy G. Thompson, Governor
George E. Meyer, Secretary
Scott A. Humrickhouse, Regional Director

3550 Mormon Coulee Rd
La Crosse , Wisconsin 54601
Telephone 608-785-9000
FAX 608-785-9990

May 17, 1999

Ms. Deborah Foley
St. Paul District, Corps of Engineers
190 Fifth Street East
St. Paul, MN 55101-1638

RE: Pool 5 – Channel Management Study – Definite Project Report

Dear Ms. Foley:

The Wisconsin Department of Natural Resources has reviewed the draft Definite Project Report/Environmental Assessment for the Pool 5 Channel Management study. We are pleased with the contents of the report and do not have any specific comments.

This report represents the hard work of all the agencies working together and indicates we can balance the needs of the commercial navigation channel and provide environmental benefits. We believe the work proposed for the head end of Island 42, Belvidere Slough, and Roebuck's run are reasonable for both channel maintenance and environmental reasons. In addition, we are anxious to see the results of the island construction in Spring Lake area and the wingdam notching.

The cover letter with this report requested water quality certification. As a matter of State policy we do not issue water quality certification based on a draft Definite Project Report. However, some of the projects in this document do not require State of Wisconsin approval to proceed so we will grant water quality certification for the following projects.

- Fortify wing dam 9 (Belvidere Slough Project)
- Wingdam notching on the Wisconsin side of the channel, 17, 56, and 98 (OSIT process will be used to determine where notching material should be placed.)

Water quality certification will be issued along with a Wisconsin 30.12 permit for the following projects.

- Roebuck's Run rock liner
- Probst Lake rock liner

River Resources Forum endorsement and a modification to the Memorandum of Understanding will be needed for these projects. Water quality certification will be issued with the MOU modification.

- Island Chain E1, E2, E3
- Island Chain B1, B2

Thank you, for your continued work on Channel Management Plans for the St. Paul District.

Sincerely,

Gretchen L. Benjamin
Mississippi River Planner

C Gary Wege – USFWS, Bloomington, MN
Scot Johnson – MNDNR, Lake City, MN
Brian Brecka – WIDNR, Alma, WI
Dan Krumholz – Fountain City, WI

Mississippi River Revival

"A River for All Life"

P.O. Box 315, Winona, MN 55987-0315

5/18/99

Gary Palesh, Technical Manager
U.S. Army Corps of Engineers, St. Paul District
190 Fifth St. E.
St Paul, MN 55101-1638

Re: Comments on Draft EA, Pool 5 Channel Management Plan

Dear Mr. Palesh,

I have reviewed the Pool 5 Draft Environmental Assessment (EA) and offer the following comments:

1 As you know, the Upper Mississippi River's aquatic habitat is being severely degraded as a result of the Corp's management practices of the commercial navigation channel. The Army Corps 1997 "EMP Report to Congress" stated, "Long term habitat changes, especially those that create permanent conditions that are beyond the suitability range of river species are of great concern" (p.2-13).

2 In addition, the St. Paul District, Army Corps 1997 "Final EIS for the Nine Foot Channel" acknowledged the Corps noncompliance with the National Environmental Policy Act on page 1-4, "The major unresolved issue is the cumulative effect impacts of the continued operation and maintenance of the nine foot channel project. The public and resource agencies have expressed concerns about the future environmental quality and ecological concerns sustainability of the UMR and the Illinois Rivers. Because of these concerns, they have identified the need for a systemic quantitative cumulative impact assessment of the continued operation and maintenance of the nine foot channel of these waterways."

3 MRR is concerned with the inadequacy of the Draft Pool 5 EA, in regards to these issues. The St. Paul District should be addressing the cumulative impacts of commercial navigation in its "pool by pool" reports. The current approach is resulting in a fragmentation of the NEPA process. The Corps needs to adequately evaluate the effects of the existing structures and maintenance practices, in addition to the effects that would result from proposed projects. Until a systemic approach is taken in the EA's, the Corps will continue be in non compliance with NEPA.

4 The commercial navigation channel's greatest effect on the Upper Mississippi River, is the loss of aquatic habitat from sedimentation. The Draft Pool 5 EA fails to give quantitative data on the effects of sedimentation that would result from the proposed projects. The closest thing it offers is the "fastabs" flow modeling data on page C-3. According to Corps Hydrologist- Jon Hendricson, the Corps has the opportunity to perform sediment transport modeling to evaluate the effects of proposed projects. However, the Corps Staff need to combine the flow modeling with suspended solids, bedload and other currently available modeling t o perform the sediment transport modeling. This sediment data would allow Agencies and the Public to more effectively evaluate the merits of proposed projects.

5 The channel management planning process contained in the Draft Pool 5 EA is resulting in a systematic hardening of the river and loss of connectivity between the channel and other

5 cont'd aquatic areas of the river. The proposed use of river training structures to reduce Army Corps maintenance costs would come at the expense of the river's ecosystem and also at the expense of my Organization's Members who use the river. The Mississippi River Revival opposes the Corps philosophy of "navigation on the cheap" which is clearly exemplified in the proposed enlargement of wingdams 84 and 85, in the Draft Pool 5 EA.

6 Table A-1 (page C-3) shows that the proposed enlargement of wing dam 84 will result in a 16.4 percent decrease in current, during normal flow. Corps Hydrologist - Jon Hendricson, has stated that the project will result in increased sedimentation of aquatic habitat down stream from the area. In addition, MN DNR Hydrologist, Scott Johnson has written in his comments to the Corps, "It is our recommendation that the Corps postpone the extension and reconstruction of wing dam 84 and 85 until the Roebuck's Run partial closing structure effects on sediment transport are fully monitored and evaluated. As you are aware, the main channel's sediment transport efficiency was greatly enhanced by the Weaver Bottoms project. Maintenance dredging is now required further downstream beyond the endorsed Channel Maintenance Management Plan's dredge material containment sites. The extension and reconstruction of wing dams 84 and 85 would likely aggravate this problem. In addition, the rock fill and sediment deposition caused by the reduced velocities associated with the wing dam extensions would require wetland mitigation/compensation."

7 Wing dams 84 and 85 should not constructed because they will clearly contribute to the violation of Wisconsin's Water Quality Standards NR103.03 and Minnesota Rules 7050.0210 Subp.13a. This in turn would be a violation of section 401 of the Clean Water Act, which must result in the denial of the 404 process approval by your Agency.

8 In addition, the proposed placement of 4300 square meters of rock across Roebucks Run side channel must be disapproved by the Corps and State Permitting Agencies. Table A-1 shows that current would be maintained through the side channel by the enlargement of wing dams 84 and 85. Corps Hydrologist - Jon Hendricson, concurs with this conclusion. If enlargement of wing dams 84 and 85 are not approved, current through Roebucks Run would be significantly decreased, again resulting in violation of Wisconsin's Water Quality Standards NR103.03 and Minnesota Rules 7050.0210 Subp.13a.

9 I want to give you positive comments for the innovative use of wing dam notching. I know this letter is severe, but I feel that a "line needs to be drawn in the sediment" in order to prevent the projected future collapse of the river's aquatic ecosystem. The Army Corps must start to comply with the Clean Water Act and the National Environmental Policy Act.

Riverinely,

Sol Simon, Director MRR

cc: Gretchen Benjamin WI DNR, Judy Mader MPCA, Scott Johnson MN DNR

June 4, 1999

Project Management Branch
Planning, Programs and Project Management Division

Mr. Sol Simon
Director
Mississippi River Revival
P.O. Box 315
Winona, Minnesota 55987-0315

Dear Mr. Simon:

This is in response to your May 18, 1999, letter of comment on the draft Definite Project Report/Environmental Assessment for the Pool 5 Channel Management Study.

Your opposition to the stabilization of Roebuck's Run and the modification of wing dams 84 and 85 will be taken into consideration in making the final recommendations concerning these features. In general, we disagree with your conclusions that these features will result in the violation of State water quality standards. This determination will be made by State regulatory agencies as part of the Section 401 water quality certification process.

Specific responses to the concerns expressed in your letter are addressed in the enclosure. If you have any questions, please contact me at (651) 290-5282 or at gary.d.palesh@mvp02.usace.army.mil.

Sincerely,

/S/

Gary Palesh
Project Manager

Enclosure

Copy furnished:

Gretchen Benjamin, WDNR
Scot Johnson, MDNR
Judy Mader, MPCA

Responses to Mississippi River Revival (MRR) Comments on the Draft DPR/EA for the Pool 5 Channel Management Study

1. Comment noted. Channel management planning, such as that completed for pool 5, is a process we are using to improve both environmental and navigation conditions on the Upper Mississippi River.

2. Comment noted.

3. Comment noted. The environmental assessment for this study addresses cumulative effects as required by the National Environmental Policy Act (NEPA) and implementing regulations. The principle of tiering, as defined in NEPA regulations, is to work from the large and general to the small and specific; i.e., programmatic or more general NEPA documents that address the overall project or program effects, and specific NEPA documents that address smaller actions of a project or program in a more specific manner. The St. Paul District has on file two programmatic Environmental Impact Statements (EIS's) for the 9-Foot Channel Navigation project, the operation and maintenance EIS completed in 1974 and the EIS for the Channel Maintenance Management Plan (CMMP) completed in 1996. Both of these documents describe the cumulative effects of channel maintenance activities on the Upper Mississippi River. While the MRR may consider these EIS's inadequate from a NEPA compliance perspective, the point is moot relative to the Pool 5 Channel Management Study and NEPA compliance requirements. The environmental assessment for the Pool 5 and other channel management studies is designed to address the environmental effects of the recommended actions of the study, not to readdress the large-scale or systemic effects addressed by the programmatic EIS's. The comment implies that the environmental assessment for the Pool 5 Channel Management Study should readdress the large- scale or systemic effects covered by programmatic NEPA documents, which is the exact opposite of the intent of the tiering principle outlined in NEPA regulations.

4. The basic concern with sedimentation on the Upper Mississippi River is the filling in of backwater and other off-channel habitats, primarily with fine sediments, but in some instances sand material also. The only recommended features from the current study that may have an effect on sedimentation of off-channel habitats are the Probst Lake entrance channel stabilization and the stabilization of the entrance to Roebuck's Run. Though not their primary purpose, both of these features will reduce sedimentation of off-channel habitats. We believe it is unnecessary to attempt to quantify the sedimentation effects of these features, because of the relatively minor effects they will have on sedimentation and because the effects are expected to be generally positive.

All of the other recommended features will result in changes in scour and deposition patterns within the main channel and main channel border portions of the river. Attempting to quantify these bathymetric changes would be very difficult and expensive. Given the scope of the proposed features, we believe it is more practical to construct the individual project features and monitor the changes that occur. If the features do not perform as intended, or have unacceptable

adverse effects, they can be modified as necessary ("adaptive management," to use a term currently popular with river managers).

5. The recommended features resulting from this study benefiting channel maintenance and/or navigation involve the modification of 3 of the 170 existing channel structures in pool 5, the stabilization of the head of Island 42, and the stabilization of the Roebuck's Run opening (which also has a habitat purpose). We would not characterize this as a "systemic hardening of the river." We are charged with maintaining the navigation project and intend to do so in as economical a manner as possible consistent with environmental requirements. It is doubtful that proposed features resulting from this study will have any effect on the river ecosystem. Most of the effects, beneficial and adverse, will be relatively localized.

6. The primary purpose of the Roebuck's Run stabilization is to prevent the further loss of flow to the Belvidere Slough area, to reduce potential increases in channel maintenance requirements, to reduce potential increases in outdraft problems, and to accommodate the recommendations of the Weaver Bottoms Resource Analysis Program. The primary purpose of the wing dam 84 and 85 modifications is to narrow and deepen the navigation channel and reduce the frequency of shoaling and marginal channel conditions in this area. This is a relatively localized change, and any increases in downstream dredging requirements are expected to occur at the Lower Zumbro dredge cut, and even those should be relatively minor. We do not expect the effects of these minor modifications to be translated into increased dredging requirements in the Minneiska-Mount Vernon Light area of the lower pool. Therefore, we see no need from a sediment transport perspective to delay construction of wing dams 84 and 85.

7. We do not believe that the modification of wing dams 84 and 85 will result in a violation of State water quality standards, and we have not received any indication from either the Minnesota Pollution Control Agency or the Wisconsin Department of Natural Resources to this effect. Subsequent to your letter of comment, you provided a copy of 33 CFR 1323. These regulations apply to discharges or runoff from Federal facilities, not the discharge of dredged or fill material (which includes rock placement) which is covered by Section 404 of the Clean Water Act, as amended.

8. If the construction of wing dams 84 and 85 were not approved, we would adjust the thickness of the rock sill across Roebuck's Run to insure the flow split between Roebuck's Run and the main channel would remain the same. For the record, we do not believe changing the amount of flow in Roebuck's Run would result in a violation of Wisconsin water quality standards, though we would defer to the judgment of the Wisconsin Department of Natural Resources on that matter.

9. Comment noted. The channel management plan for pool 5 is in full compliance with NEPA and the Clean Water Act.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Twin Cities Field Office
4101 East 80th Street
Bloomington, Minnesota 55425-1665

JUN 04 1999

Ms. Deborah A. Foley
Chief, Project Management Branch
St. Paul District, Corps of Engineers
Army Corps of Engineers Centre
190 Fifth Street East
St. Paul, Minnesota 55101-1638

Dear Ms. Foley:

This replies to your recent letter requesting U.S. Fish and Wildlife Service (Service) comments on the Definite Project Report for the Pool 5 Channel Management Study on the Upper Mississippi River in Wisconsin and Minnesota.

The Service supports the recommendations of the Pool 5 Channel Management Study and has no substantive comments to offer at this time. We appreciate the efforts of District staff and other agency personnel in working together on this study effort which will benefit fish and wildlife, commercial navigation and recreation.

Thank you for the opportunity to review the Definite Project Report. We look forward to participating in the channel management study process for other pools in the District.

Our comments have been prepared under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; U.S.C. 661 et seq.), the National Environmental Policy Act and the Fish and Wildlife Service's Mitigation Policy.
This proposal was also examined for its conformance with the Endangered Species Act of 1973, as amended and Executive Orders 11988 and 11990. Please contact Mr. Gary Wege at (612) 725-3548 ext. 207 if you have any questions on these comments.

Sincerely,

R. Nicholas Rowse

R. Nicholas Rowse
Acting Field Supervisor

cc: Minnesota Department of Natural Resources, St. Paul, Minnesota
Minnesota Department of Natural Resources, Lake City, Minnesota
Wisconsin Department of Natural Resources, La Crosse, Wisconsin

Appendix G

Habitat Evaluation

APPENDIX G - Habitat Evaluation

Over 200 structures in pool 5 were assessed for habitat deficiencies and the potential for implementation of restoration/enhancement measures. Through a series of interagency meetings and on-site inspections the list was screened to those structures with the following habitat deficiencies:

1. Secondary or tertiary channels that have been occluded with sediments as a result of channel control structures. These areas lack bathymetric diversity, generally containing water depths less than 1 meter. Flow also is seasonally restricted.

2. Secondary and tertiary channels that feed backwater lakes, ponds, marshes that are providing excessive or insufficient flows and sediment input for the desired habitat conditions.

3. There is a lack of structural diversity in shallow and deep water wing dam fields. The basic assumption in this identified resource problem is that biological diversity is often associated with physical heterogeneity. Therefore, the goal of the notching was to create a complex of depth-velocity-substrate types within existing wing dam fields where there is a high degree of uniformity in these habitat parameters.

The smallmouth bass habitat suitability model, with modifications to incorporate some of the in-stream flow model curves, was used in the analysis of wing dam notching. The following general assumptions were used to evaluate the effects of the wing dam notching:

1. It was assumed that the notch and scour hole would change, but remain over the 50-year project life. It was also assumed that under the no action alternative habitat conditions would remain comparable over the next 50 years.

2. Scour holes in shallow main channel border habitat in pool 5 vary in size from 0.1 ha to 1.1 ha. The average size of scour holes was estimated to be 0.5 ha, which was used in the habitat benefits' calculation as an estimate of the size of the scour hole that might develop as a result of wing dam notching.

3. In the main channel border habitat in pool 5 where scour holes exist, the scour holes occupy from 10 to 100% of the area downstream of the wing dam up to the next channel training structure.

4. The major variables in the smallmouth bass model that would be modified as a result of wing dam notching are substrate types, percent pool/water depth, percent cover, and current velocity. The notch will expose some of the rock that has been buried by sand and create small pockets of gravel in the scour area. Re-exposing rock substrate and creation of rock groins or mounds will increase the amount of cover available. The notch will locally increase current in the notch area and decrease current in the deeper scour area that is created, increasing the diversity of the current velocity pattern.

5. For comparative purposes, some of the wing dams (68,36,45,85) that were considered by the agencies to have adequate habitat conditions were also evaluated. Notching some of these structures could potentially be justified, but it was decided to focus only on the areas with the poorest quality habitat.

Table G-1 provides a summary of the habitat analysis for the wing dam notching, with tables G-2

through G-9 providing the specific analysis for each structure.

The bluegill habitat suitability model, with modifications for winter conditions, was used to evaluate the potential measures for Probst Lake. The analysis is summarized in table G-10.

The other recommended measures in the Pool 5 CMP, including the work at the mouths of West Newton, Belvidere Slough, and Roebucks Run; restoration/modification of wing dams 84 and 85; and construction of small islands (1 to 5) in lower pool, are being done to improve channel maintenance and/or provide for long-term placement. Although some habitat benefits may accrue as a result of these actions, they were justified based on the benefits to the operation and maintenance program. Therefore, a habitat analysis was not considered necessary for these recommended features.

Table G-1. Summary of habitat analysis for wing dam notching.

Wingdam	Acres	HSI - No action	HSI - With notch	Habitat unit gain	Average annual costs	Average annual costs per habitat unit
30	164.2	0.52	0.53	1.54	$455	$296
29	103.1	0.52	0.54	1.49	$455	$304
4	70.6	0.52	0.54	1.02	$455	$445
33	103.1	0.52	0.53	0.97	$455	$471
83	5.9	0.45	0.58	0.78	$415	$530
69,70 & 72	21.3	0.45	0.56	2.43	$1,325	$545
98	3.6	0.45	0.60	0.56	$415	$745
56	3.1	0.45	0.62	0.53	$415	$782
106	2.9	0.45	0.62	0.50	$415	$836
65	2.9	0.45	0.62	0.50	$415	$836
71	7.3	0.45	0.56	0.83	$830	$996
68	4.6	0.56	0.63	0.34	$415	$1,216
36	5.3	0.61	0.65	0.24	$415	$1,709
17	3.2	0.45	0.61	0.53	$925	$1,758
45	5.8	0.64	0.65	0.11	$415	$3,778
85	1.7	0.64	0.57	-0.10	$415	($3,996)

*Bolded and underlined wing dams are those recommended for implementation.

Table G-2. Habitat analysis for notching wing dams 56 and 98.

HABITAT SUITABILITY IMODEL FOR SMALLMOUTH BASS

		Wing dam notching - wing dam 56				Wing dam notching - wing dam 98			
		No action		With Notch		No action		With Notch	
Variable	Description	# of acres	3.1	Average annual cos	$415	# of acres	3.6	Average annual cost	$415
		DATA	HSI	DATA	HSI	DATA	HSI	DATA	HSI
V1	Substrate Type - Incubation	Sand/cobble	0.20	Sand/gravel/cobble	0.30	Sand/cobble	0.20	Sand/gravel/cobble	0.30
	Substrate Type - Spawning	Sand/cobble	0.20	Sand/gravel/cobble	0.30	Sand/cobble	0.20	Sand/gravel/cobble	0.30
	Substrate Type - Juvenile	Sand/cobble	0.20	Sand/gravel/cobble	0.30	Sand/cobble	0.20	Sand/gravel/cobble	0.30
	Substrate Type - Adult	Sand/cobble	0.20	Sand/gravel/cobble	0.30	Sand/cobble	0.20	Sand/gravel/cobble	0.30
V2	% Pools	<10%	0.10	42%	0.80	<10%	0.10	35%	0.60
V4	Pool Depth (meters)	~1	0.50	~ 2	1.00	~1	0.50	~ 2	1.00
V5	% cover	5%	0.10	7%	0.15	5%	0.10	7%	0.15
V6	pH	Class A	1.00	Class A	1.00	Class A	1.00	Class A	1.00
V8	Dissolved oxygen	>5	1.00	>5	1.00	>5	1.00	>5	1.00
V9	Turbidity	25-50	0.80	25-50	0.80	25-50	0.80	25-50	0.80
V10	Temperature - adult (C)	20-29	1.00	20-29	1.00	20-29	1.00	20-29	1.00
V11	Temperature - embryo (C)	20-29	0.90	20-29	0.90	20-29	0.90	20-29	0.90
V12	Temperature - fry (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V13	Temperature - juvenile (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V14	Water level fluctuations	Class A	0.50	Class A-C	0.50	Class A	0.50	Class A-C	0.50
V15	Gradient	NF	0.80	NF	0.80	NF	0.80	NF	0.80
V16	Ave. Current Vel. (spawning)(Not	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V17	Ave. Current (Fry)	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V18	Ave. Current (Juvenile)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
V19	Ave. Current Vel. (Adult)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
	Food (Cf)= ((average of v1 values)*v5*v7)1/3		0.13		0.33		0.13		0.30
	Cover (Cc) = ((average v1 values)+v5+v6+v7)/4		0.19		0.39		0.19		0.37
	Water Quality (Cwq)		0.93		0.93		0.93		0.93
	Reproduction (Cr)		0.58		0.63		0.58		0.63
	Other (Cot)(v15+v16+v17+v18+v19)/5		0.68		0.80		0.68		0.80
	HSI		0.45		0.62		0.45		0.60
	Average Annual HU increase		N/A		0.53		N/A		0.56
	Average Annual Cost/Habitat Unit				**$782**				**$745**

Note: Model was modified to include current velocity as a variable with the use of the Instream Flow Methods curves contained in smallmouth bass HEP model.

Table G-3. Habitat analysis for notching wing dams 65 and 106.

HABITAT SUITABILITY IMODEL FOR SMALLMOUTH BASS

		Wing dam notching - wing dam 65				Wing dam notching - wing dam 106			
		No action		With Notch		No action		With Notch	
Variable	**Description**	**# of acres**	**2.9**	**Average annual cos**	**$415**	**# of acres**	**2.9**	**Average annual cost**	**$415**
		DATA	HSI	DATA	HSI	DATA	HSI	DATA	HSI
V1	Substrate Type - Incubation	Sand/cobble	0.20	Sand/gravel/cobble	0.30	Sand/cobble	0.20	Sand/gravel/cobble	0.30
	Substrate Type - Spawning	Sand/cobble	0.20	Sand/gravel/cobble	0.30	Sand/cobble	0.20	Sand/gravel/cobble	0.30
	Substrate Type - Juvenile	Sand/cobble	0.20	Sand/gravel/cobble	0.30	Sand/cobble	0.20	Sand/gravel/cobble	0.30
	Substrate Type - Adult	Sand/cobble	0.20	Sand/gravel/cobble	0.30	Sand/cobble	0.20	Sand/gravel/cobble	0.30
V2	% Pools	<10%	0.10	42%	0.80	<10%	0.10	42%	0.80
V4	Pool Depth (meters)	~1	0.50	~ 2	1.00	~1	0.50	~ 2	1.00
V5	% cover	5%	0.10	7%	0.15	5%	0.10	7%	0.15
V6	pH	Class A	1.00	Class A	1.00	Class A	1.00	Class A	1.00
V8	Dissolved oxygen	>5	1.00	>5	1.00	>5	1.00	>5	1.00
V9	Turbidity	25-50	0.80	25-50	0.80	25-50	0.80	25-50	0.80
V10	Temperature - adult (C)	20-29	1.00	20-29	1.00	20-29	1.00	20-29	1.00
V11	Temperature - embryo (C)	20-29	0.90	20-29	0.90	20-29	0.90	20-29	0.90
V12	Temperature - fry (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V13	Temperature - juvenile (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V14	Water level fluctuations	Class A	0.50	Class A-C	0.50	Class A	0.50	Class A-C	0.50
V15	Gradient	NF	0.80	NF	0.80	NF	0.80	NF	0.80
V16	Ave. Current Vel. (spawning)(Not	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V17	Ave. Current (Fry)	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V18	Ave. Current (Juvenile)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
V19	Ave. Current Vel. (Adult)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
	Food (Cf)= ((average of v1 values)*v5*v7)1/3		0.13		0.33		0.13		0.33
	Cover (Cc) = ((average v1 values)+v5+v6+v7)/4		0.19		0.39		0.19		0.39
	Water Quality (Cwq)		0.93		0.93		0.93		0.93
	Reproduction (Cr)		0.58		0.63		0.58		0.63
	Other (Cot)(v15+v16+v17+v18+v19)/5		0.68		0.80		0.68		0.80
	HSI		0.45		0.62		0.45		0.62
	Average Annual HU increase		N/A		0.50		N/A		0.50
	Average Annual Cost/Habitat Unit				**$836**				**$836**

Note: Model was modified to include current velocity as a variable with the use of the Instream Flow Methods curves contained in smallmouth bass HEP model.

Table G-4. Habitat analysis for notching wing dams 71 and 83.

HABITAT SUITABILITY IMODEL FOR SMALLMOUTH BASS

		Wing dam notching - wing dam 71				Wing dam notching - wing dam 83			
		No action		With Notch		No action		With Notch	
Variable	Description	# of acres	7.3	Average annual cos	$830	# of acres	5.9	Average annual cost	$415
		DATA	HSI	DATA	HSI	DATA	HSI	DATA	HSI
V1	Substrate Type - Incubation	Sand/cobble	0.20	Sand/gravel/cobble	0.30	Sand/cobble	0.20	Sand/gravel/cobble	0.30
	Substrate Type - Spawning	Sand/cobble	0.20	Sand/gravel/cobble	0.30	Sand/cobble	0.20	Sand/gravel/cobble	0.30
	Substrate Type - Juvenile	Sand/cobble	0.20	Sand/gravel/cobble	0.30	Sand/cobble	0.20	Sand/gravel/cobble	0.30
	Substrate Type - Adult	Sand/cobble	0.20	Sand/gravel/cobble	0.30	Sand/cobble	0.20	Sand/gravel/cobble	0.30
V2	% Pools	<10%	0.10	17%	0.30	<10%	0.10	29%	0.45
V4	Pool Depth (meters)	~1	0.50	~ 1.5	0.80	~1	0.50	~ 1.5	0.80
V5	% cover	5%	0.10	7%	0.15	10%	0.10	15%	0.15
V6	pH	Class A	1.00	Class A	1.00	Class A	1.00	Class A	1.00
V8	Dissolved oxygen	>5	1.00	>5	1.00	>5	1.00	>5	1.00
V9	Turbidity	25-50	0.80	25-50	0.80	25-50	0.80	25-50	0.80
V10	Temperature - adult (C)	20-29	1.00	20-29	1.00	20-29	1.00	20-29	1.00
V11	Temperature - embryo (C)	20-29	0.90	20-29	0.90	20-29	0.90	20-29	0.90
V12	Temperature - fry (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V13	Temperature - juvenile (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V14	Water level fluctuations	Class A	0.50	Class A-C	0.50	Class A	0.50	Class A-C	0.50
V15	Gradient	NF	0.80	NF	0.80	NF	0.80	NF	0.80
V16	Ave. Current Vel. (spawning)(Not	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V17	Ave. Current (Fry)	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V18	Ave. Current (Juvenile)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
V19	Ave. Current Vel. (Adult)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
	Food (Cf)= ((average of v1 values)*v5*v7)1/3		0.13		0.24		0.13		0.27
	Cover (Cc) = ((average v1 values)+v5+v6+v7)/4		0.19		0.31		0.19		0.33
	Water Quality (Cwq)		0.93		0.93		0.93		0.93
	Reproduction (Cr)		0.58		0.63		0.58		0.63
	Other (Cot)(v15+v16+v17+v18+v19)/5		0.68		0.80		0.68		0.80
	HSI		0.45		0.56		0.45		0.58
	Average Annual HU increase		N/A		0.83		N/A		0.78
	Average Annual Cost/Habitat Unit				**$996**				**$530**

Note: Model was modified to include current velocity as a variable with the use of the Instream Flow Methods curves contained in smallmouth bass HEP model.

Table G-5. Habitat analysis for notching wing dams 4 and 29.

HABITAT SUITABILITY IMODEL FOR SMALLMOUTH BASS

		Wing dam notching - wing dam 4				Wing dam notching - wing dam 29			
		No action		With Notch		No action		With Notch	
Variable	Description	# of acres	70.6	Average annual cos	$455	# of acres	103.1	Average annual cost	$455
		DATA	HSI	DATA	HSI	DATA	HSI	DATA	HSI
V1	Substrate Type - Incubation	Sand/cobble	0.20	Sand/gravel/cobble	0.22	Sand/cobble	0.20	Sand/gravel/cobble	0.22
	Substrate Type - Spawning	Sand/cobble	0.20	Sand/gravel/cobble	0.22	Sand/cobble	0.20	Sand/gravel/cobble	0.22
	Substrate Type - Juvenile	Sand/cobble	0.20	Sand/gravel/cobble	0.22	Sand/cobble	0.20	Sand/gravel/cobble	0.22
	Substrate Type - Adult	Sand/cobble	0.20	Sand/gravel/cobble	0.22	Sand/cobble	0.20	Sand/gravel/cobble	0.22
V2	% Pools	100%	0.20	99%	0.22	100%	0.20	99%	0.22
V4	Pool Depth (meters)	>2	1.00	>2	1.00	>2	1.00	>2	1.00
V5	% cover	10%	0.20	10%	0.20	10%	0.20	15%	0.20
V6	pH	Class A	1.00	Class A	1.00	Class A	1.00	Class A	1.00
V8	Dissolved oxygen	>5	1.00	>5	1.00	>5	1.00	>5	1.00
V9	Turbidity	25-50	0.80	25-50	0.80	25-50	0.80	25-50	0.80
V10	Temperature - adult (C)	20-29	1.00	20-29	1.00	20-29	1.00	20-29	1.00
V11	Temperature - embryo (C)	20-29	0.90	20-29	0.90	20-29	0.90	20-29	0.90
V12	Temperature - fry (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V13	Temperature - juvenile (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V14	Water level fluctuations	Class A	0.50	Class A-C	0.50	Class A	0.50	Class A-C	0.50
V15	Gradient	NF	0.80	NF	0.80	NF	0.80	NF	0.80
V16	Ave. Current Vel. (spawning)(Not	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V17	Ave. Current (Fry)	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V18	Ave. Current (Juvenile)	0.5 - 1	0.50	0 - 2	0.60	0.5 - 1	0.50	0 - 2	0.60
V19	Ave. Current Vel. (Adult)	0.5 - 1	0.50	0 - 2	0.60	0.5 - 1	0.50	0 - 2	0.60
	Food (Cf)= ((average of v1 values)*v5*v7)1/3		0.20		0.21		0.20		0.21
	Cover (Cc) = ((average v1 values)+v5+v6+v7)/4		0.28		0.29		0.28		0.29
	Water Quality (Cwq)		0.93		0.93		0.93		0.93
	Reproduction (Cr)		0.63		0.63		0.63		0.63
	Other (Cot)(v15+v16+v17+v18+v19)/5		0.68		0.72		0.68		0.72
	HSI		0.52		0.54		0.52		0.54
	Average Annual HU increase		N/A		1.02		N/A		1.49
	Average Annual Cost/Habitat Unit				**$445**				**$304**

Note: Model was modified to include current velocity as a variable with the use of the Instream Flow Methods curves contained in smallmouth bass HEP model.

Table G-6. Habitat analysis for notching wing dams 30 and 33.

HABITAT SUITABILITY IMODEL FOR SMALLMOUTH BASS

		Wing dam notching - wing dam 30				Wing dam notching - wing dam 33			
		No action		With Notch		No action		With Notch	
Variable	**Description**	**# of acres**	**164.2**	**Average annual cos**	**$455**	**# of acres**	**103.1**	**Average annual cost**	**$455**
		DATA	HSI	DATA	HSI	DATA	HSI	DATA	HSI
V1	Substrate Type - Incubation	Sand/cobble	0.20	Sand/gravel/cobble	0.21	Sand/cobble	0.20	Sand/gravel/cobble	0.21
	Substrate Type - Spawning	Sand/cobble	0.20	Sand/gravel/cobble	0.21	Sand/cobble	0.20	Sand/gravel/cobble	0.21
	Substrate Type - Juvenile	Sand/cobble	0.20	Sand/gravel/cobble	0.21	Sand/cobble	0.20	Sand/gravel/cobble	0.21
	Substrate Type - Adult	Sand/cobble	0.20	Sand/gravel/cobble	0.21	Sand/cobble	0.20	Sand/gravel/cobble	0.21
V2	% Pools	100%	0.20	99%	0.21	100%	0.20	99%	0.21
V4	Pool Depth (meters)	>2	1.00	>2	1.00	>2	1.00	>2	1.00
V5	% cover	10%	0.20	10%	0.20	10%	0.20	10%	0.20
V6	pH	Class A	1.00	Class A	1.00	Class A	1.00	Class A	1.00
V8	Dissolved oxygen	>5	1.00	>5	1.00	>5	1.00	>5	1.00
V9	Turbidity	25-50	0.80	25-50	0.80	25-50	0.80	25-50	0.80
V10	Temperature - adult (C)	20-29	1.00	20-29	1.00	20-29	1.00	20-29	1.00
V11	Temperature - embryo (C)	20-29	0.90	20-29	0.90	20-29	0.90	20-29	0.90
V12	Temperature - fry (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V13	Temperature - juvenile (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V14	Water level fluctuations	Class A	0.50	Class A-C	0.50	Class A	0.50	Class A-C	0.50
V15	Gradient	NF	0.80	NF	0.80	NF	0.80	NF	0.80
V16	Ave. Current Vel. (spawning)(Not	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V17	Ave. Current (Fry)	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V18	Ave. Current (Juvenile)	0.5 - 1	0.50	0 - 2	0.60	0.5 - 1	0.50	0 - 2	0.60
V19	Ave. Current Vel. (Adult)	0.5 - 1	0.50	0 - 2	0.60	0.5 - 1	0.50	0 - 2	0.60
	Food (Cf)= ((average of v1 values)*v5*v7)1/3		0.20		0.21		0.20		0.21
	Cover (Cc) = ((average v1 values)+v5+v6+v7)/4		0.28		0.28		0.28		0.28
	Water Quality (Cwq)		0.93		0.93		0.93		0.93
	Reproduction (Cr)		0.63		0.62		0.63		0.62
	Other (Cot)(v15+v16+v17+v18+v19)/5		0.68		0.72		0.68		0.72
	HSI		0.52		0.53		0.52		0.53
	Average Annual HU increase		N/A		1.54		N/A		0.97
	Average Annual Cost/Habitat Unit				**$296**				**$471**

Note: Model was modified to include current velocity as a variable with the use of the Instream Flow Methods curves contained in smallmouth bass HEP model.

Table G-7. Habitat analysis for notching wing dams 69, 70,72 and 17.

HABITAT SUITABILITY IMODEL FOR SMALLMOUTH BASS

		Secondary channel improve - notch wing dam 69,70 & 72				Secondary channel improvement - notch wing dam 17			
		No action		With Notch		No action		With Notch	
Variable	Description	# of acres	21.3	Average annual cos	$1,325	Average annual cos	3.2	AAC	$925
		DATA	HSI	DATA	HSI	DATA	HSI	DATA	HSI
V1	Substrate Type - Incubation	Sand/cobble	0.20	Sand/gravel/cobble	0.30	Sand/cobble	0.20	Sand/gravel/cobble	0.30
	Substrate Type - Spawning	Sand/cobble	0.20	Sand/gravel/cobble	0.30	Sand/cobble	0.20	Sand/gravel/cobble	0.30
	Substrate Type - Juvenile	Sand/cobble	0.20	Sand/gravel/cobble	0.30	Sand/cobble	0.20	Sand/gravel/cobble	0.30
	Substrate Type - Adult	Sand/cobble	0.20	Sand/gravel/cobble	0.30	Sand/cobble	0.20	Sand/gravel/cobble	0.30
V2	% Pools	<10%	0.10	17%	0.30	<10%	0.10	39%	0.80
V4	Pool Depth (meters)	~1	0.50	~ 1.5	0.80	~1	0.50	~ 1.5	0.80
V5	% cover	10%	0.10	15%	0.15	10%	0.10	15%	0.15
V6	pH	Class A	1.00	Class A	1.00	Class A	1.00	Class A	1.00
V8	Dissolved oxygen	>5	1.00	>5	1.00	>5	1.00	>5	1.00
V9	Turbidity	25-50	0.80	25-50	0.80	25-50	0.80	25-50	0.80
V10	Temperature - adult (C)	20-29	1.00	20-29	1.00	20-29	1.00	20-29	1.00
V11	Temperature - embryo (C)	20-29	0.90	20-29	0.90	20-29	0.90	20-29	0.90
V12	Temperature - fry (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V13	Temperature - juvenile (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V14	Water level fluctuations	Class A	0.50	Class A-C	0.50	Class A	0.50	Class A-C	0.50
V15	Gradient	NF	0.80	NF	0.80	NF	0.80	NF	0.80
V16	Ave. Current Vel. (spawning)(Not	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V17	Ave. Current (Fry)	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V18	Ave. Current (Juvenile)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
V19	Ave. Current Vel. (Adult)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
	Food (Cf)= ((average of v1 values)*v5*v7)1/3		0.13		0.24		0.13		0.33
	Cover (Cc) = ((average v1 values)+v5+v6+v7)/4		0.19		0.31		0.19		0.37
	Water Quality (Cwq)		0.93		0.93		0.93		0.93
	Reproduction (Cr)		0.58		0.63		0.58		0.63
	Other (Cot)(v15+v16+v17+v18+v19)/5		0.68		0.80		0.68		0.80
	HSI		0.45		0.56		0.45		0.61
	Average Annual HU increase		N/A		2.43		N/A		0.53
	Average Annual Cost/Habitat Unit				**$545**				**$1,758**

Note: Model was modified to include current velocity as a variable with the use of the Instream Flow Methods curves contained in smallmouth bass HEP model.

Table G-8. Habitat analysis for notching wing dams 68 and 45.

HABITAT SUITABILITY IMODEL FOR SMALLMOUTH BASS

		Wing dam notching - wing dam 68				Wing dam notching - wing dam 45			
		No action		With Notch		No action		With Notch	
Variable	**Description**	**# of acres**	**4.6**	**Average annual cos**	**$415**	**# of acres**	**5.8**	**Average annual cost**	**$415**
		DATA	HSI	DATA	HSI	DATA	HSI	DATA	HSI
V1	Substrate Type - Incubation	Sand/gravel/cobble	0.25	Sand/gravel/cobble	0.30	Sand/gravel/cobble	0.25	Sand/gravel/cobble	0.30
	Substrate Type - Spawning	Sand/gravel/cobble	0.25	Sand/gravel/cobble	0.30	Sand/gravel/cobble	0.25	Sand/gravel/cobble	0.30
	Substrate Type - Juvenile	Sand/gravel/cobble	0.25	Sand/gravel/cobble	0.30	Sand/gravel/cobble	0.25	Sand/gravel/cobble	0.30
	Substrate Type - Adult	Sand/gravel/cobble	0.25	Sand/gravel/cobble	0.30	Sand/gravel/cobble	0.25	Sand/gravel/cobble	0.30
V2	% Pools	14%	0.22	40%	0.70	46%	1.00	67%	1.00
V4	Pool Depth (meters)	>2	1.00	>2	1.00	>2	1.00	>2	1.00
V5	% cover	10%	0.20	12%	0.22	10%	0.20	12%	0.22
V6	pH	Class A	1.00	Class A	1.00	Class A	1.00	Class A	1.00
V8	Dissolved oxygen	>5	1.00	>5	1.00	>5	1.00	>5	1.00
V9	Turbidity	25-50	0.80	25-50	0.80	25-50	0.80	25-50	0.80
V10	Temperature - adult (C)	20-29	1.00	20-29	1.00	20-29	1.00	20-29	1.00
V11	Temperature - embryo (C)	20-29	0.90	20-29	0.90	20-29	0.90	20-29	0.90
V12	Temperature - fry (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V13	Temperature - juvenile (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V14	Water level fluctuations	Class A	0.50	Class A-C	0.50	Class A	0.50	Class A-C	0.50
V15	Gradient	NF	0.80	NF	0.80	NF	0.80	NF	0.80
V16	Ave. Current Vel. (spawning)(Not	0 - 2	0.80	0 - 2	0.80	0 - 2	0.80	0 - 2	0.80
V17	Ave. Current (Fry)	0 - 2	0.80	0 - 2	0.80	0 - 2	0.80	0 - 2	0.80
V18	Ave. Current (Juvenile)	0 - 2	0.80	0 - 2	0.80	0 - 2	0.80	0 - 2	0.80
V19	Ave. Current Vel. (Adult)	0 - 2	0.80	0 - 2	0.80	0 - 2	0.80	0 - 2	0.80
	Food (Cf)= ((average of v1 values)*v5*v7)1/3		0.22		0.36		0.37		0.40
	Cover (Cc) = ((average v1 values)+v5+v6+v7)/4		0.30		0.39		0.40		0.43
	Water Quality (Cwq)		0.93		0.93		0.93		0.93
	Reproduction (Cr)		0.64		0.65		0.64		0.65
	Other (Cot)(v15+v16+v17+v18+v19)/5		0.80		0.80		0.80		0.80
	HSI		0.56		0.63		0.64		0.65
	Average Annual HU increase		N/A		0.34		N/A		0.11
	Average Annual Cost/Habitat Unit				**$1,216**				**$3,778**

Note: Model was modified to include current velocity as a variable with the use of the Instream Flow Methods curves contained in smallmouth bass HEP model.

Table G-9. Habitat analysis for notching wing dams 36 and 85.

HABITAT SUITABILITY IMODEL FOR SMALLMOUTH BASS

		Wing dam notching - wing dam 36				Wing dam notching - wing dam 45			
		No action		With Notch		No action		With Notch	
Variable	**Description**	**# of acres**	**5.3**	**Average annual cos**	**$415**	**# of acres**	**1.7**	**Average annual cost**	**$415**
		DATA	HSI	DATA	HSI	DATA	HSI	DATA	HSI
V1	Substrate Type - Incubation	Sand/gravel/cobble	0.25	Sand/gravel/cobble	0.30	Sand/gravel/cobble	0.25	Sand/gravel/cobble	0.30
	Substrate Type - Spawning	Sand/gravel/cobble	0.25	Sand/gravel/cobble	0.30	Sand/gravel/cobble	0.25	Sand/gravel/cobble	0.30
	Substrate Type - Juvenile	Sand/gravel/cobble	0.25	Sand/gravel/cobble	0.30	Sand/gravel/cobble	0.25	Sand/gravel/cobble	0.30
	Substrate Type - Adult	Sand/gravel/cobble	0.25	Sand/gravel/cobble	0.30	Sand/gravel/cobble	0.25	Sand/gravel/cobble	0.30
V2	% Pools	33%	0.65	55%	1.00	49%	1.00	99%	0.21
V4	Pool Depth (meters)	>2	1.00	>2	1.00	>2	1.00	>2	1.00
V5	% cover	10%	0.20	12%	0.22	10%	0.20	12%	0.22
V6	pH	Class A	1.00	Class A	1.00	Class A	1.00	Class A	1.00
V8	Dissolved oxygen	>5	1.00	>5	1.00	>5	1.00	>5	1.00
V9	Turbidity	25-50	0.80	25-50	0.80	25-50	0.80	25-50	0.80
V10	Temperature - adult (C)	20-29	1.00	20-29	1.00	20-29	1.00	20-29	1.00
V11	Temperature - embryo (C)	20-29	0.90	20-29	0.90	20-29	0.90	20-29	0.90
V12	Temperature - fry (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V13	Temperature - juvenile (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V14	Water level fluctuations	Class A	0.50	Class A-C	0.50	Class A	0.50	Class A-C	0.50
V15	Gradient	NF	0.80	NF	0.80	NF	0.80	NF	0.80
V16	Ave. Current Vel. (spawning)(Not	0 - 2	0.80	0 - 2	0.80	0 - 2	0.80	0 - 2	0.80
V17	Ave. Current (Fry)	0 - 2	0.80	0 - 2	0.80	0 - 2	0.80	0 - 2	0.80
V18	Ave. Current (Juvenile)	0 - 2	0.80	0 - 2	0.80	0 - 2	0.80	0 - 2	0.80
V19	Ave. Current Vel. (Adult)	0 - 2	0.80	0 - 2	0.80	0 - 2	0.80	0 - 2	0.80
	Food (Cf)= ((average of v1 values)*v5*v7)1/3		0.32		0.40		0.37		0.24
	Cover (Cc) = ((average v1 values)+v5+v6+v7)/4		0.36		0.43		0.40		0.33
	Water Quality (Cwq)		0.93		0.93		0.93		0.93
	Reproduction (Cr)		0.64		0.65		0.64		0.65
	Other (Cot)(v15+v16+v17+v18+v19)/5		0.80		0.80		0.80		0.80
	HSI		0.61		0.65		0.64		0.57
	Average Annual HU increase		N/A		0.24		N/A		-0.10
	Average Annual Cost/Habitat Unit				**$1,709**				**($3,996)**

Note: Model was modified to include current velocity as a variable with the use of the Instream Flow Methods curves contained in smallmouth bass HEP model.

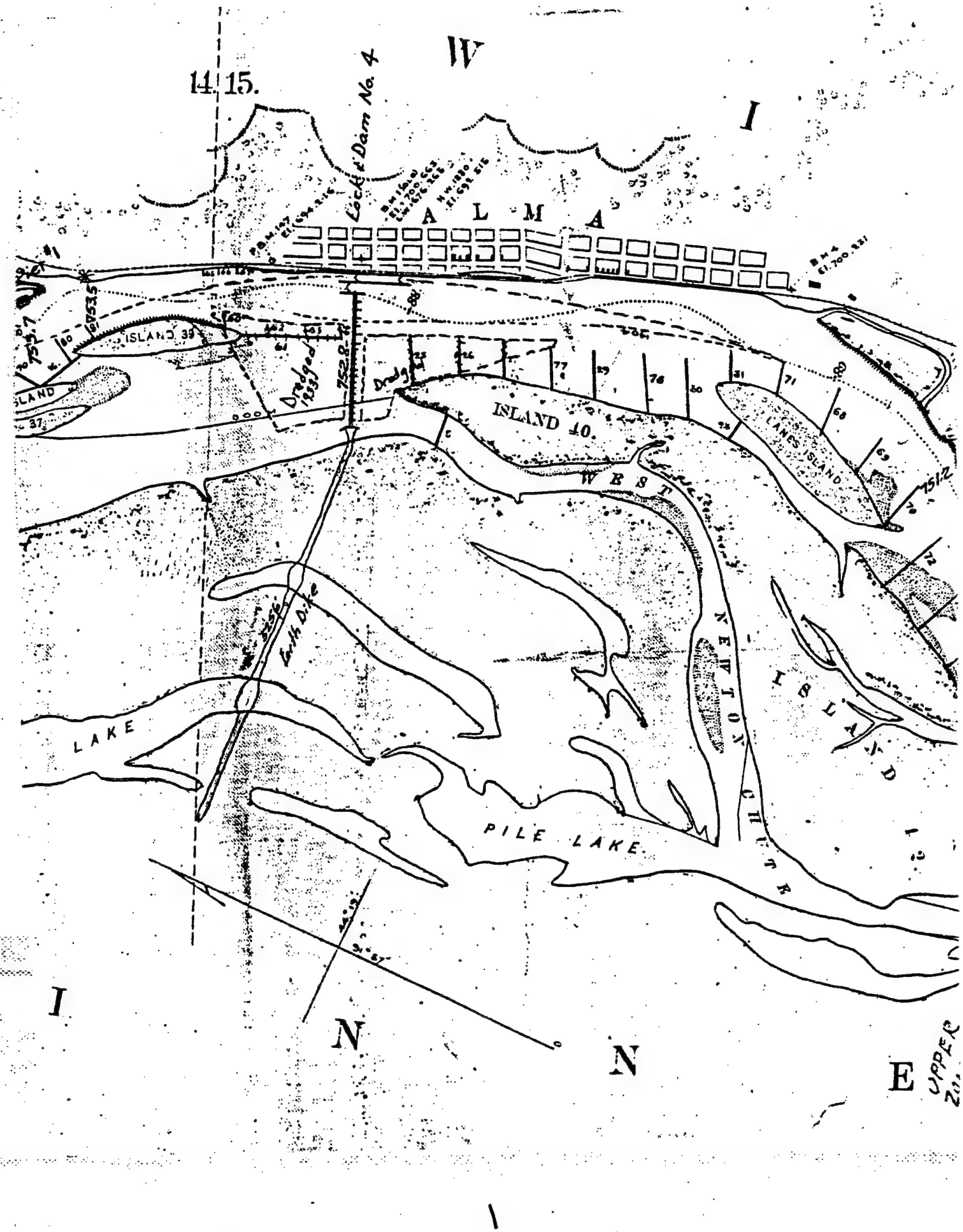
Table G-10. Bluegill Model - Probst Lake

Habitat Suitability Index Model for Bluegills

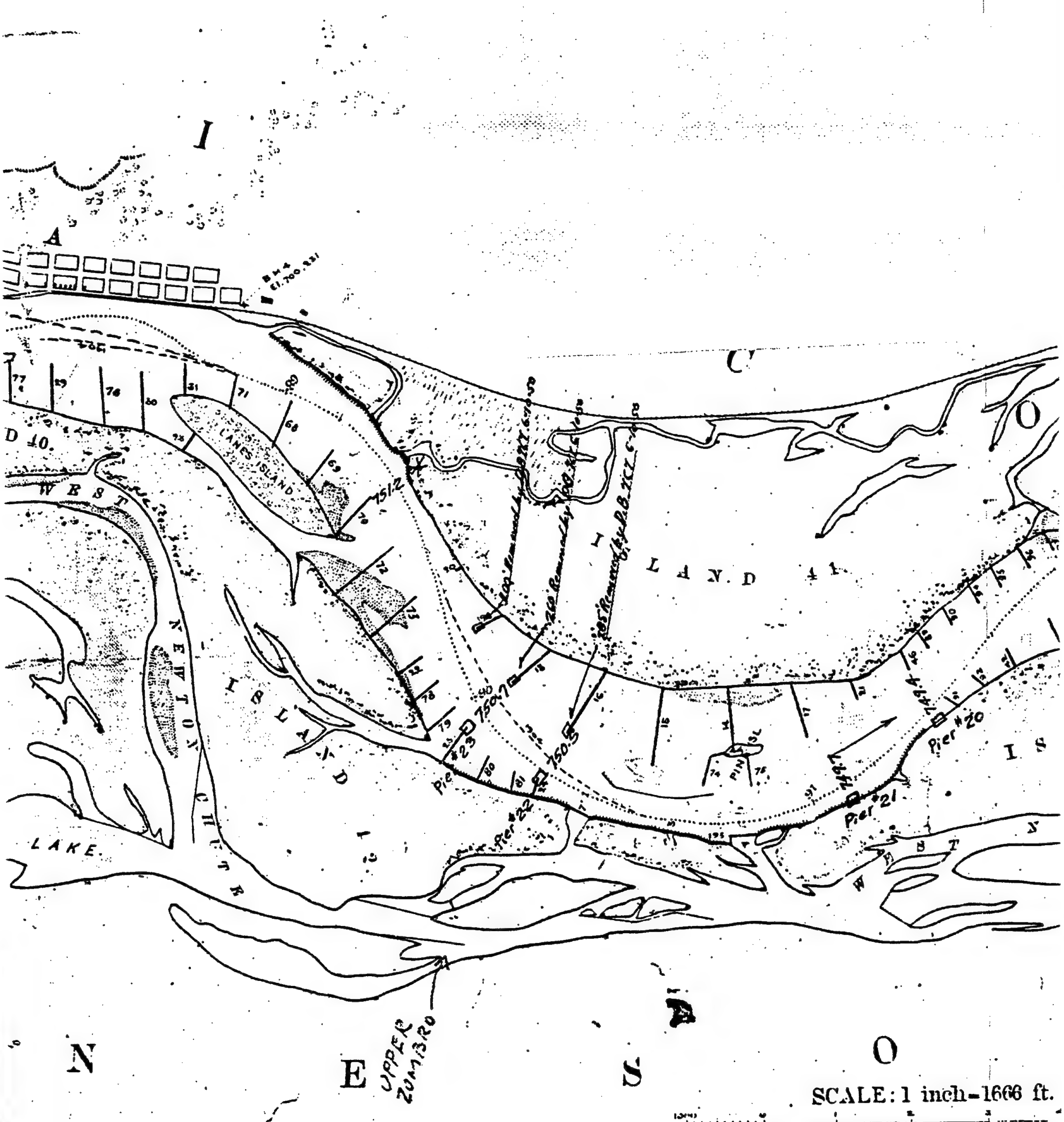
Variable	Description	No action (Year 1) & with project (year 1 & 10) HSI	Assumptions	No action (Year 10) & with project (Year 50) HSI	Assumptions	No action ((Year 50) HSI	Assumptions
V1	% Pool Area	0.80	Value = around 50%	0.75	Value = around 45%	0.60	Value = around 40%
V2	% Cover (Logs & Brush)	0.60	Value = around 15%	0.60	Value = around 15%	0.60	Value = around 15%
V3	% Cover (Vegetation)	0.70	Value = around 50%	0.70	Value = around 50%	0.70	Value = around 50%
V4	% Littoral Area	1.00	Value = around 50%	1.00	Value = around 60%	0.80	Value = around 70%
V5	Ave. TDS	1.00	Assumed to be maximum	1.00	Assumed to be maximum	1.00	Assumed to be maximum
V6	Ave. Turbidity	1.00	Assumed to be maximum	1.00	Assumed to be maximum	1.00	Assumed to be maximum
V7	pH Range	1.00	Assumed to be maximum	1.00	Assumed to be maximum	1.00	Assumed to be maximum
V8	Min. D.O. Summer	1.00	Assume adequate circulation to maintain DO above 5 mg/l	1.00	Assume adequate circulation to maintain DO above 5 mg/l	1.00	Assume adequate circulation to maintain DO above 5 mg/l
V10	Max. Midsummer Temp.(Adult)	1.00	Assumed to be maximum	1.00	Assumed to be maximum	1.00	Assumed to be maximum
V11	Ave. Water Temp. (Spawning)	1.00	Assumed to be maximum	1.00	Assumed to be maximum	1.00	Assumed to be maximum
V12	Max. Early Summer Temp.(Fry)	1.00	Assumed to be maximum	1.00	Assumed to be maximum	1.00	Assumed to be maximum
V13	Max. Midsummer Temp.(Juvenile)	1.00	Assumed to be maximum	1.00	Assumed to be maximum	1.00	Assumed to be maximum
V14	Ave. Current	1.00	Negligible current - Assumed to be maximum	1.00	Increased summer current velocity ~ 5 cm/sec	1.00	Increased summer current velocity ~ 10 cm/sec
V15	Ave. Current (Spawning)	1.00	Negligible current - Assumed to be maximum	1.00	Increased summer current velocity ~ 5 cm/sec	0.90	Increased summer current velocity ~ 10 cm/sec
V16	Ave. Current (Fry)	1.00	Negligible current - Assumed to be maximum	0.90	Increased summer current velocity ~ 5 cm/sec	0.20	Increased summer current velocity ~ 10 cm/sec
V17	Ave. Current (Juvenile)	1.00	Negligible current - Assumed to be maximum	0.95	Increased summer current velocity ~ 5 cm/sec	0.50	Increased summer current velocity ~ 10 cm/sec
V18	Stream Gradient	1.00	Assumed to be maximum	1.00	Assumed to be maximum	1.00	Assumed to be maximum
V19	Reservoir Drawdown	1.00	Assumed to be maximum	1.00	Assumed to be maximum	1.00	Assumed to be maximum
V20	Substrate Composition	1.00	Assumed to be maximum	1.00	Assumed to be maximum	1.00	Assumed to be maximum
	Food (Cf)	0.70		0.68		0.63	
	Cover (Cc)	0.65		0.65		0.65	
	Water Quality (Cwq)	0.86		0.86		0.86	
	Reproduction (Cr)	1.00		1.00		0.97	
	Other (Cot)	1.00		0.98		0.78	
	HSI	0.83		0.83		0.78	
WITH WINTER HSI MODIFICATIONS Variable	Description	HSI		HSI		HSI	
Va	Water Depth	0.70	Assumed to be around 25%	0.70	Decrease to 24%	0.63	Decrease to 20%
Vb	Dissolved Oxygen	0.90	> 5mg /l	0.90	> 5mg /l	0.90	> 5mg /l
Vc	Water Temperature	0.85	Assumed to be around 3 degrees C	0.68	Assumed to be around 2 degrees C	0.50	Assumed to be around 1 degrees C
Vd	Current Velocity	0.90	Negligible current	0.70	Increased winter current velocity ~ 0.5 cm/sec	0.43	Increased winter current velocity ~ 1 cm/sec
	Winter Cover (Cw-q)	0.70		0.70		0.63	
	Winter Water Quality(Cw-wq)	0.88		0.83		0.77	
	Corrected Cw-wq(see note 1)	0.75		0.80		0.77	
	Winter Other (Cw-ot)	0.90		0.70		0.43	
	Winter HSI	0.84		0.76		0.63	
	Corrected Winter HSI(see note 2)	0.84		0.76		0.63	
	Composite HSI with winter mods.	0.83		0.79		0.70	

Note 1: If Vb or Vc is < or = 0.4 Cw-wq equals the lowest of these variables
Note 2: If Vb, Vc, or Vd is < or = 0.4 use the lowest variable as the Winter HSI

	No Action Alternative		With Action Alternative	
Target Year	Acres	HSI	Acres	HSI
1	44.0	0.83	44.0	0.83
10	43.0	0.79	44.0	0.83
50	39.0	0.70	43.0	0.79
Average Annual Habitat Unit Gain With Project				5.03
Average Annual Cost Per Habitat Unit Gain With Project				$1,111



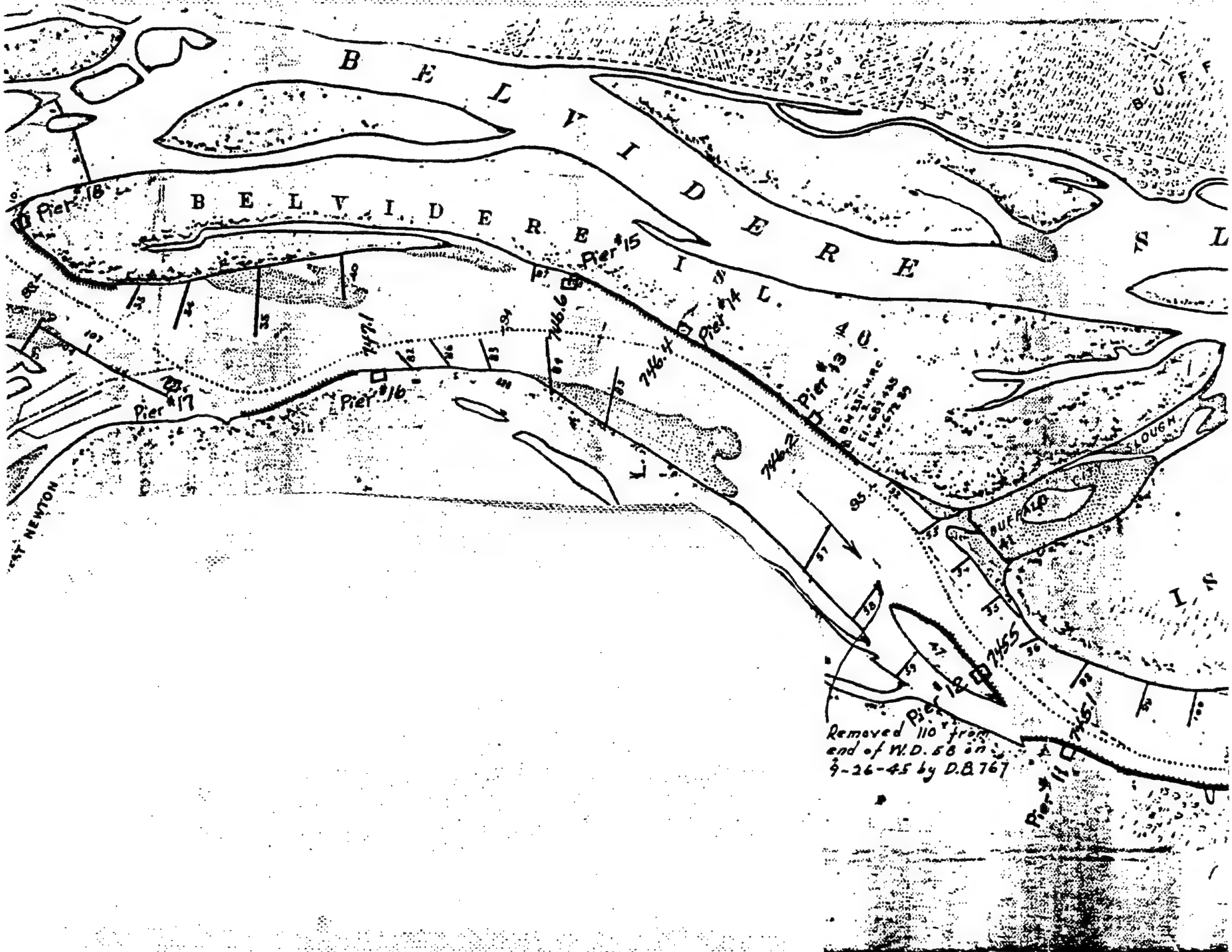
14. 15.
W
I
Lock & Dam No. 4
A L M A
ISLAND 39
ISLAND 40.
Dredged 1933
Dredged
752.8
LANES ISLAND
751.2
WEST NEWTON CHUTE
NEWTON ISLAND
Earth Dike
LAKE
PILE LAKE
I
N
N
E
UPPER


I
A
C
O
D 40.
WEST
LANES ISLAND
751.2
NEWTON CHUTE
ISLAND 12
LAND 41
LAKE
750.7
750.5
749.7
749.4
Pier #23
Pier #22
Pier #21
Pier #20
PIN ISL
IS
WEST
UPPER ZUMBRO
N
E
S
O
SCALE: 1 inch-1666 ft.


Pier 19
Pier 18
Pier #20
Pier #21
748.4
747.9
748.8
749.4
748.7
750.5
ISLAND 41
ISL. 42.
WEST NEWTON
CHUTE
WEST NEWTON
SCALE: 1 inch=1666 ft.

Plate 4a


Pier 19
Pier 18
Pier 17
B E L V
I S L. 42
N E W T O N
C H U T E



BELVIDERE
BELVIDERE ISL.
Pier #18
Pier #17
Pier #16
Pier #15
Pier #14
Pier #13
Pier #12
Pier #11
747.1
746.6
746.4
746.2
745.5
745.1
40
BUFFALO
SLOUGH
Removed 110' from end of W.D. 58 on 9-26-45 by D.B. 767

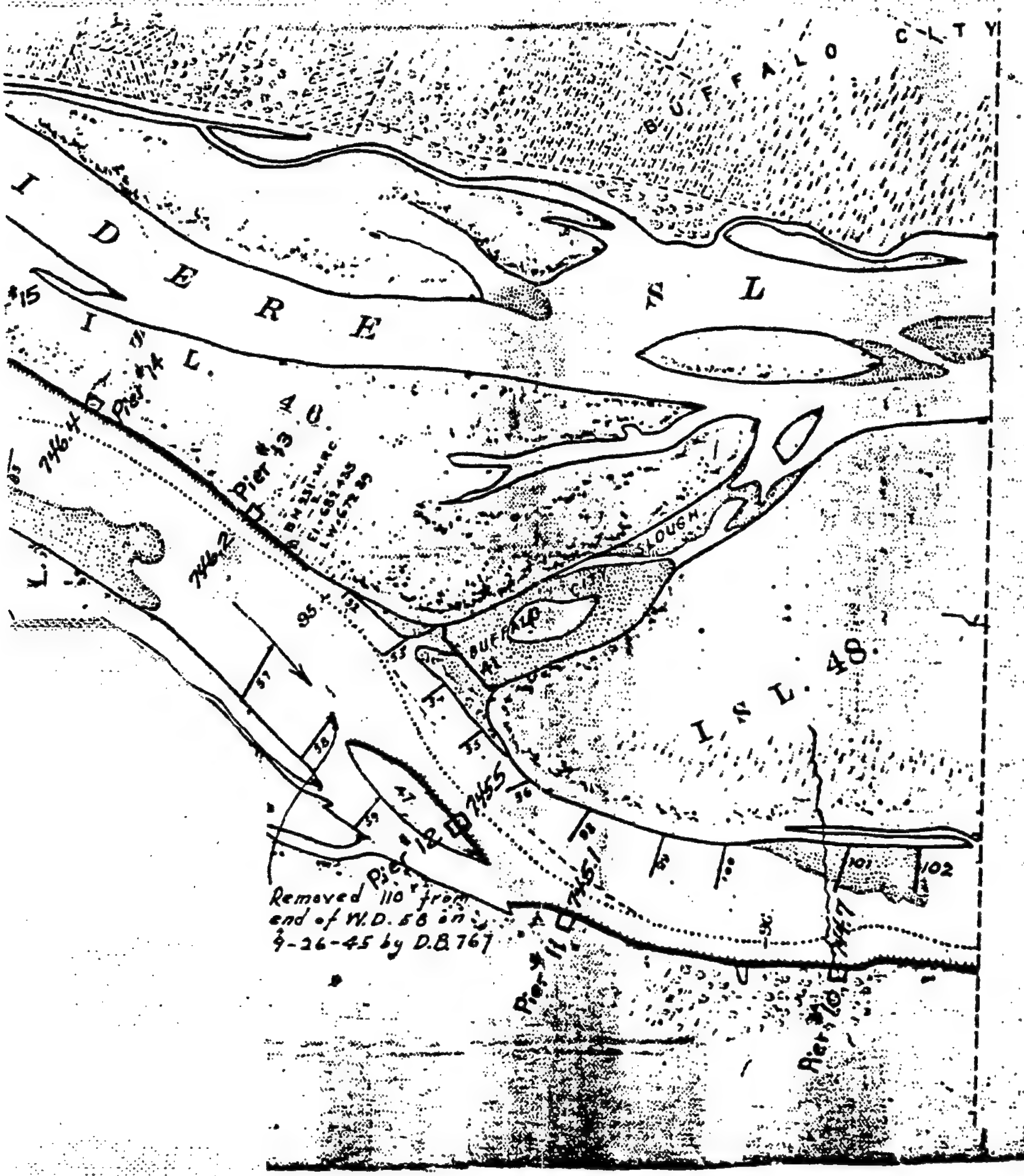
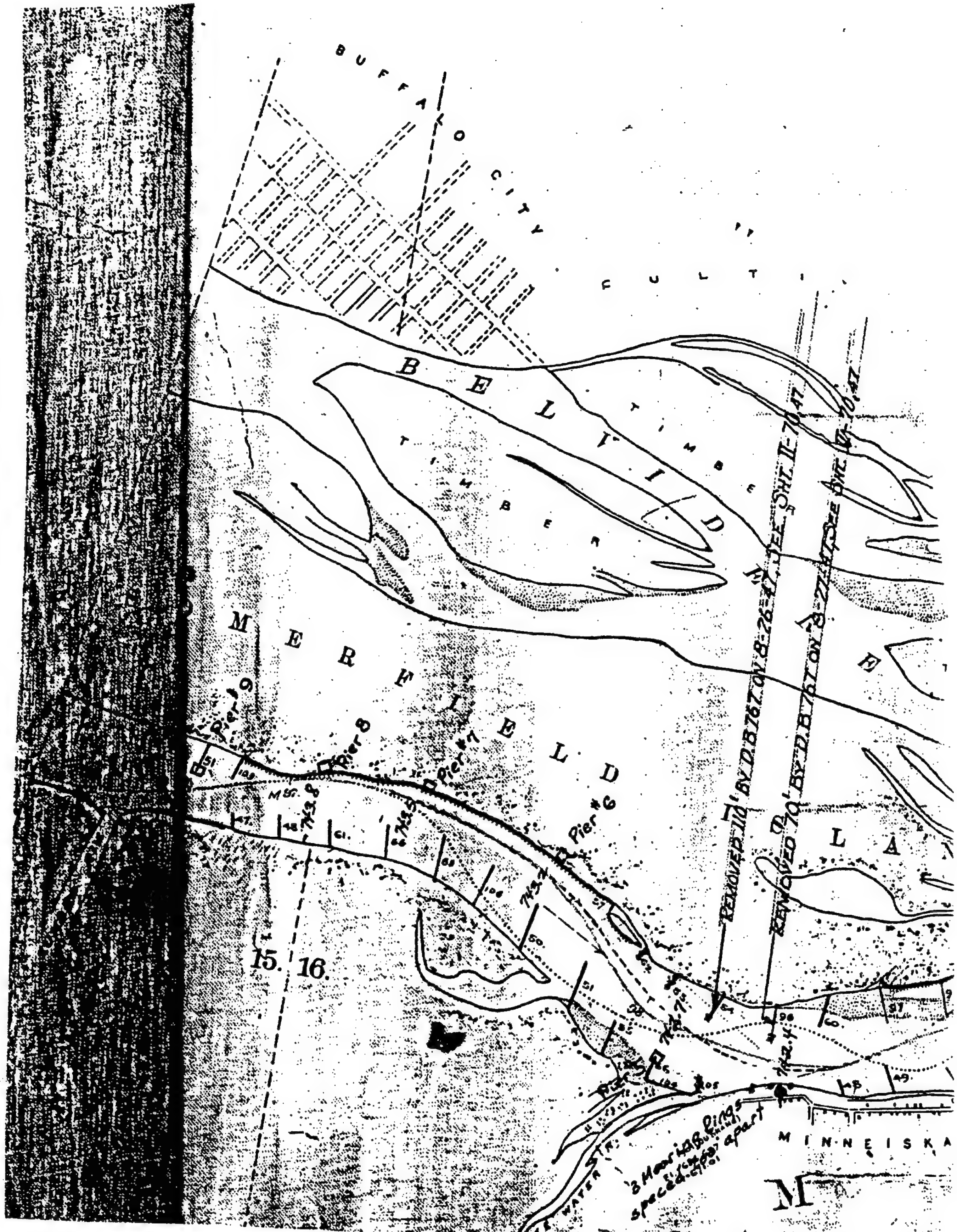
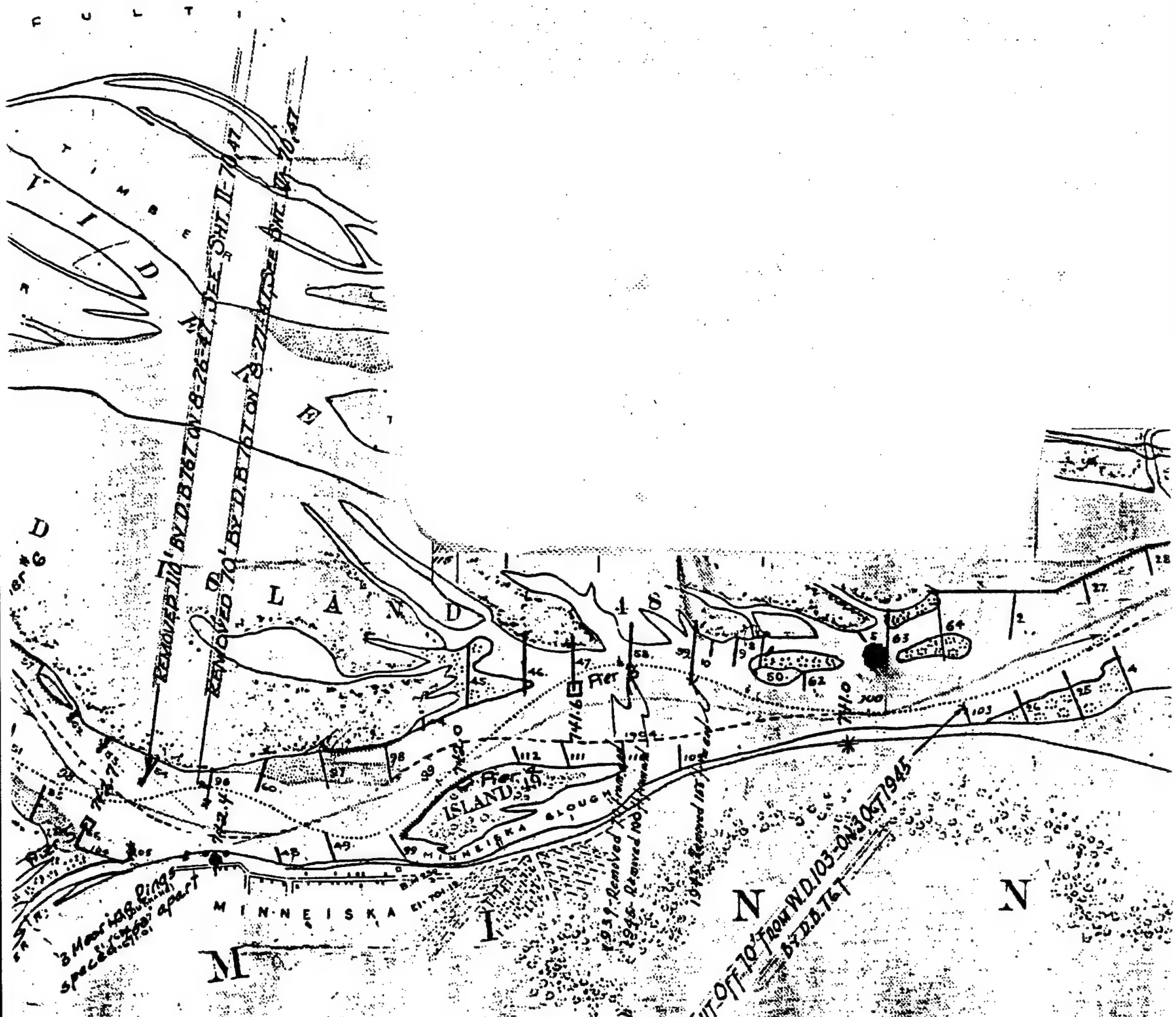

BUFFALO CITY
DERESL
ISL. 40
ISL. 48
SLOUGH
Pier #14
Pier #13
Pier #12
Pier #11
Pier #10
746.4
746.2
745.5
745.1
744.7
Removed 110' from end of W.D. 58 on 9-26-45 by D.B. 767
102

Plate 4b



BUFFALO CITY
CULTI
TIMBER
TIMBER
MERFIELD
Pier 9
Pier 8
Pier #7
Pier #6
15.
16.
MINNEISKA
WATER STR.
3 Mooring Rings spaced apart


REMOVED 110' BY D.B.767 ON 8-26-47, SEE SHT. II-10-47
REMOVED 70' BY D.B.767 ON 8-27-47, SEE SHT. II-10-47
ISLAND 46
MINNEISKA SLOUGH
MINNEISKA
1939-Removed
1946-Removed 100'
1945-Removed 115'
CUT-OFF 70' FROM W.D.103 ON 3-0-7-1945 BY D.B.767
3 Mooring Rings
741.6
741.0

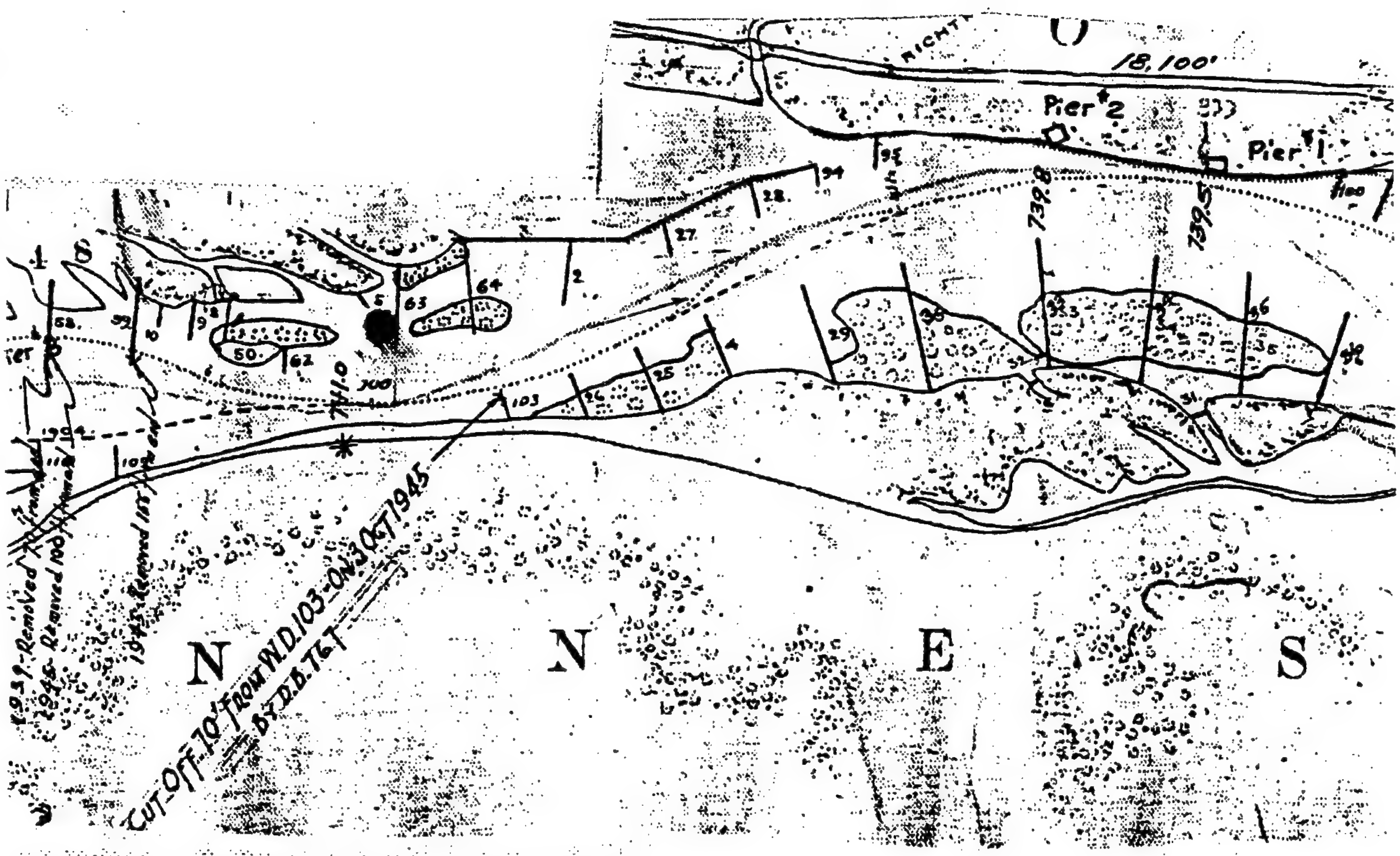
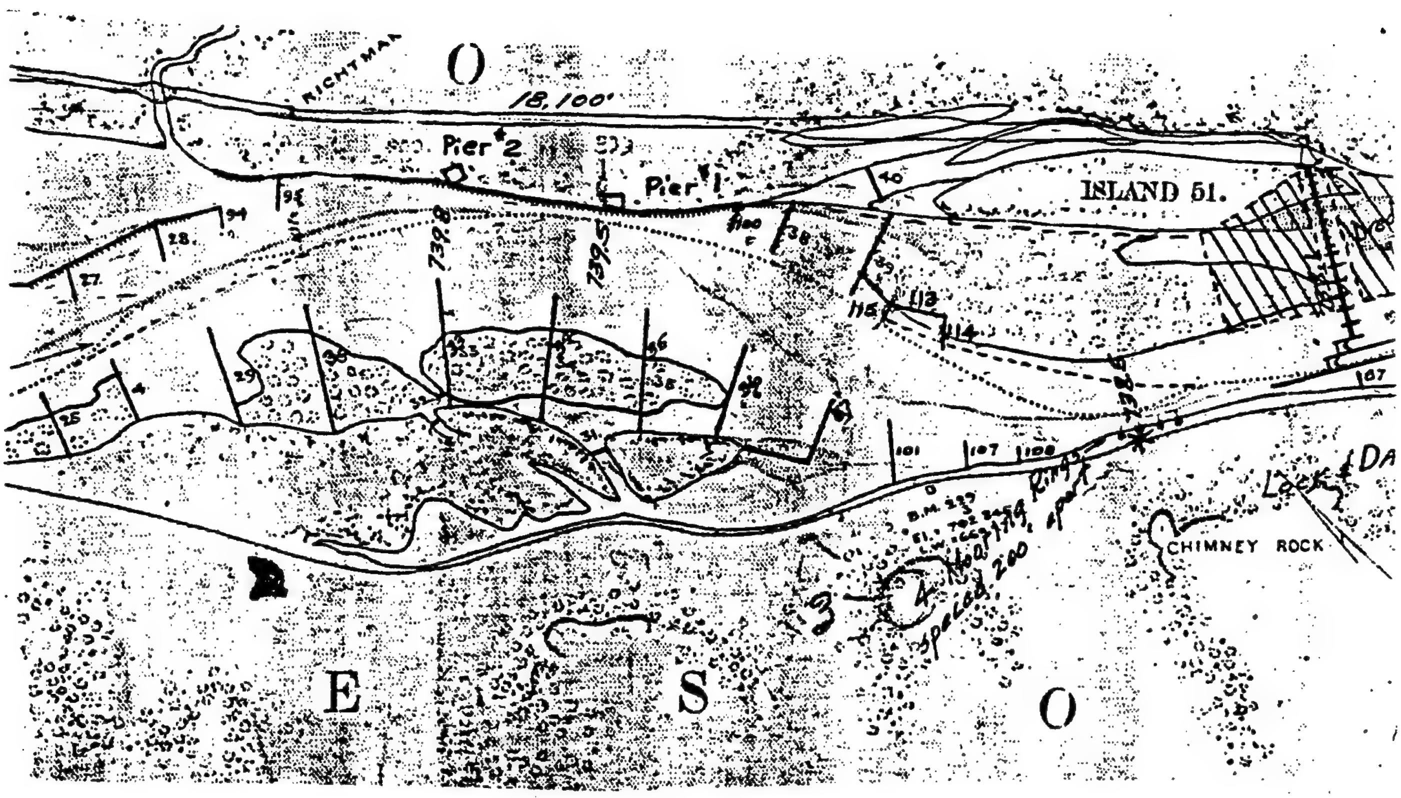
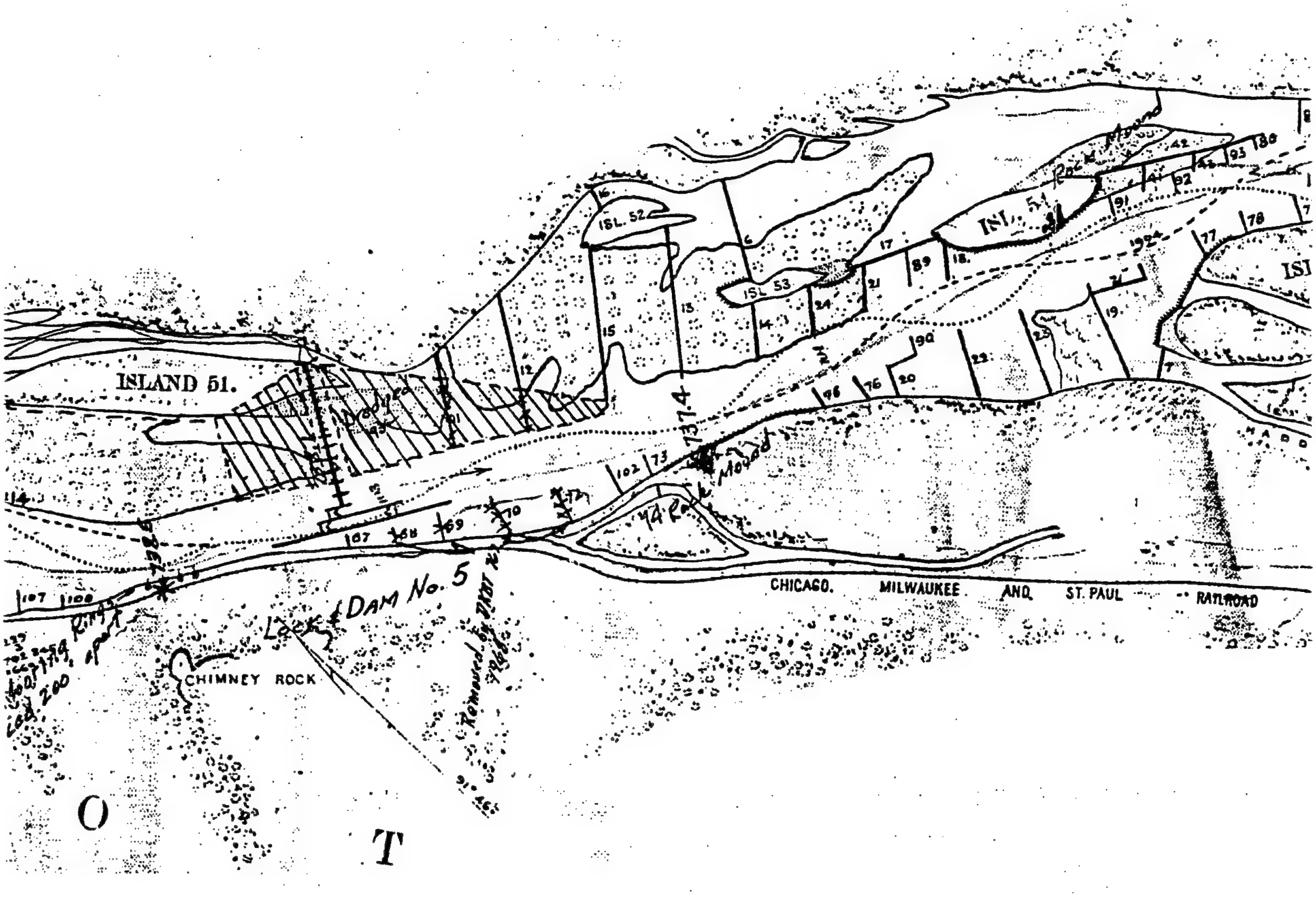
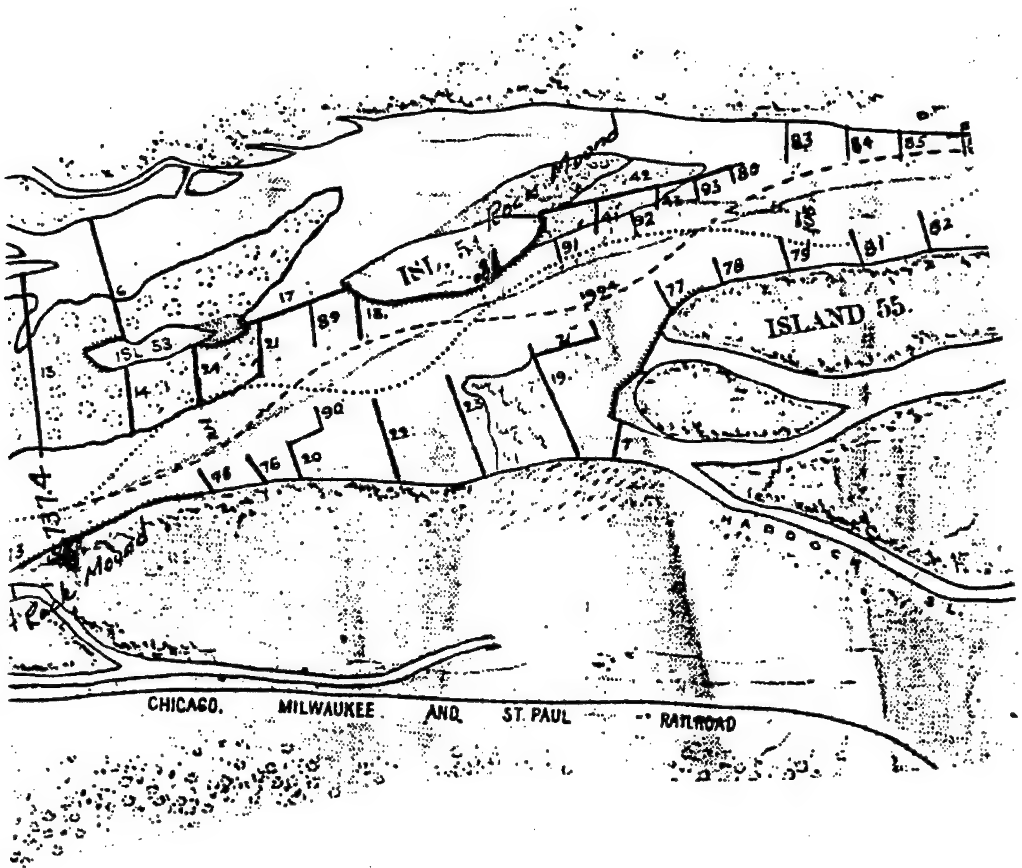


Plate 4c


O
18,100'
Pier #2
Pier #1
ISLAND 51.
739.8
739.5
CHIMNEY ROCK
E
S
O

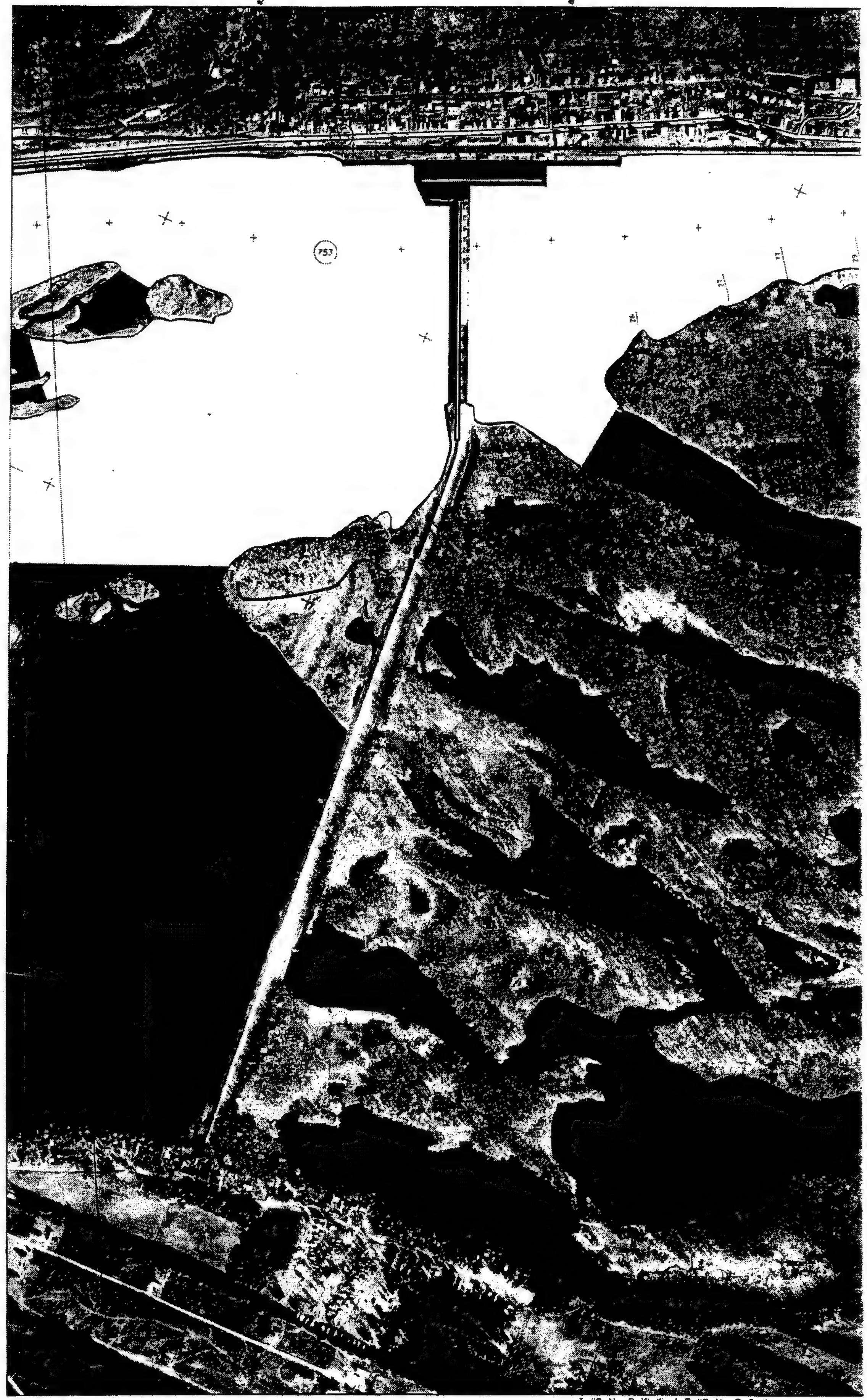


ISLAND 51.
ISL. 52
ISL. 53
ISL. 54
Rock Mound
1374
CHIMNEY ROCK
Lock & Dam No. 5
CHICAGO. MILWAUKEE AND ST. PAUL RAILROAD
O
T



ISL. 53
ISL. 54
ISLAND 55.
Rock Mound
CHICAGO. MILWAUKEE AND ST. PAUL RAILROAD
HADDOCK SL.

Plate 4d



T 110 N, R 10 W / T 110 N, R 9 W

MARKHURD


T 21 N , R 13 W
752
3,172,000
3,170,000
3,168,000
3,166,000
T 110 N , R 10 W / T 110 N , R 9 W

HUB	AZIMUTH	DISTANCE	COORDINATES		ELEVATION
			NORTH	EAST	
LD4 DGPS	3/4 I.P.		818,932.66	3,168,946.32	

NOTE

CONTROL SURVEYS FURNISHED BY ENVIROSCIENCE, INC.

THIS MAP MEETS NATIONAL MAP ACCURACY STANDARDS

COORDINATES BASED ON MINNESOTA STATE PLANE GRID SYSTEM, SOUTH ZONE, N.A. DATUM OF 1983.

DATE OF PHOTOGRAPHY: NOV., 1997

Surveyed By:________ **Launch**________ **Acres** ____

Gage Reading:______ **Location:**______ **UMR**

Individual	Initials	Date
Processor		
Unit Chief		
Channel Maintenance Coordinator		

____ 1. No Action
____ 2. Resurvey ________
____ 3. Dredge Area As Shown

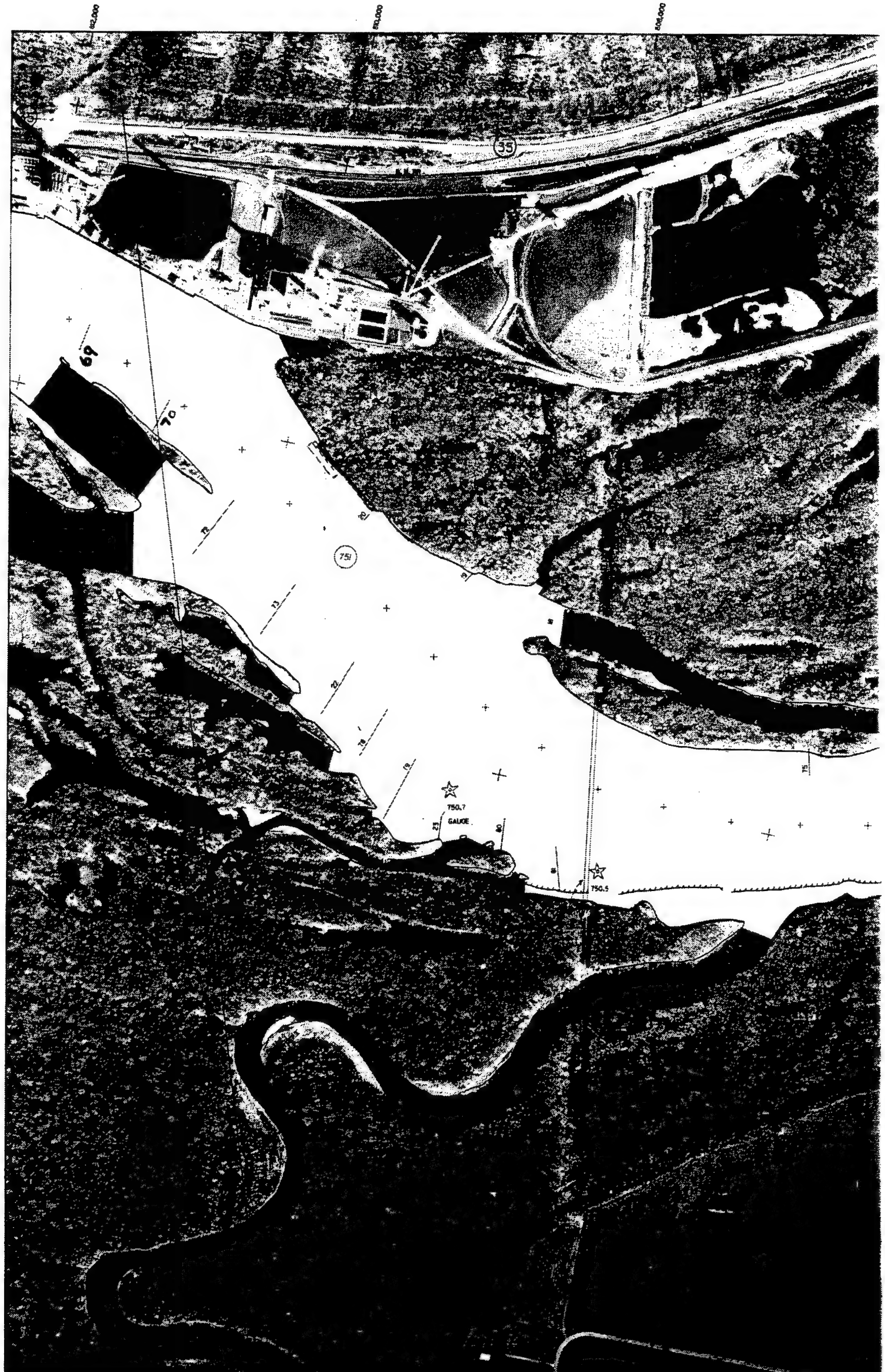
Channel Maintenance Coordinator		
Chief, Waterways Section		
Project Manager		

Remarks ________

MILE 753.0 LCP 666.5
MILE 752.0 LCP 660.0

UPPER MISSISSIPPI RIVER IMPROVEMENT ST. PAUL, MINN. DISTRICT		
L/D NO. 4 - ALMA LOWER LIGHT		
MILE 751.0 TO 753.3	SCALE 1"=400'	SHEET 4-01

Plate 5a


33
69
70
751
750.7
GAUGE
750.5


T 21 N, R 13 W
3,174,000
3,172,000
3,170,000
3,168,000
3,166,000
749
750
749.8
749.7
750.5
T 110 N, R 9 W / T 109 N, R 9 W

HUB	AZIMUTH	DISTANCE	COORDINATES NORTH	COORDINATES EAST	ELEVATION

NOTE

CONTROL SURVEYS FURNISHED BY ENVIROSCIENCE, INC.

THIS MAP MEETS NATIONAL MAP ACCURACY STANDARDS

COORDINATES BASED ON MINNESOTA STATE PLANE GRID SYSTEM, SOUTH ZONE, N.A. DATUM OF [illegible].

DATE OF PHOTOGRAPHY: NOV., 1992

Surveyed By: ________ Launch ________ Acres ____

Gage Reading: ________ Location: ________ UMR

Individual	Initials	Date
Processor	____	____
Unit Chief	____	____
Channel Maintenance Coordinator	____	____

____ 1. No Action
____ 2. Resurvey ________
____ 3. Dredge Area As Shown

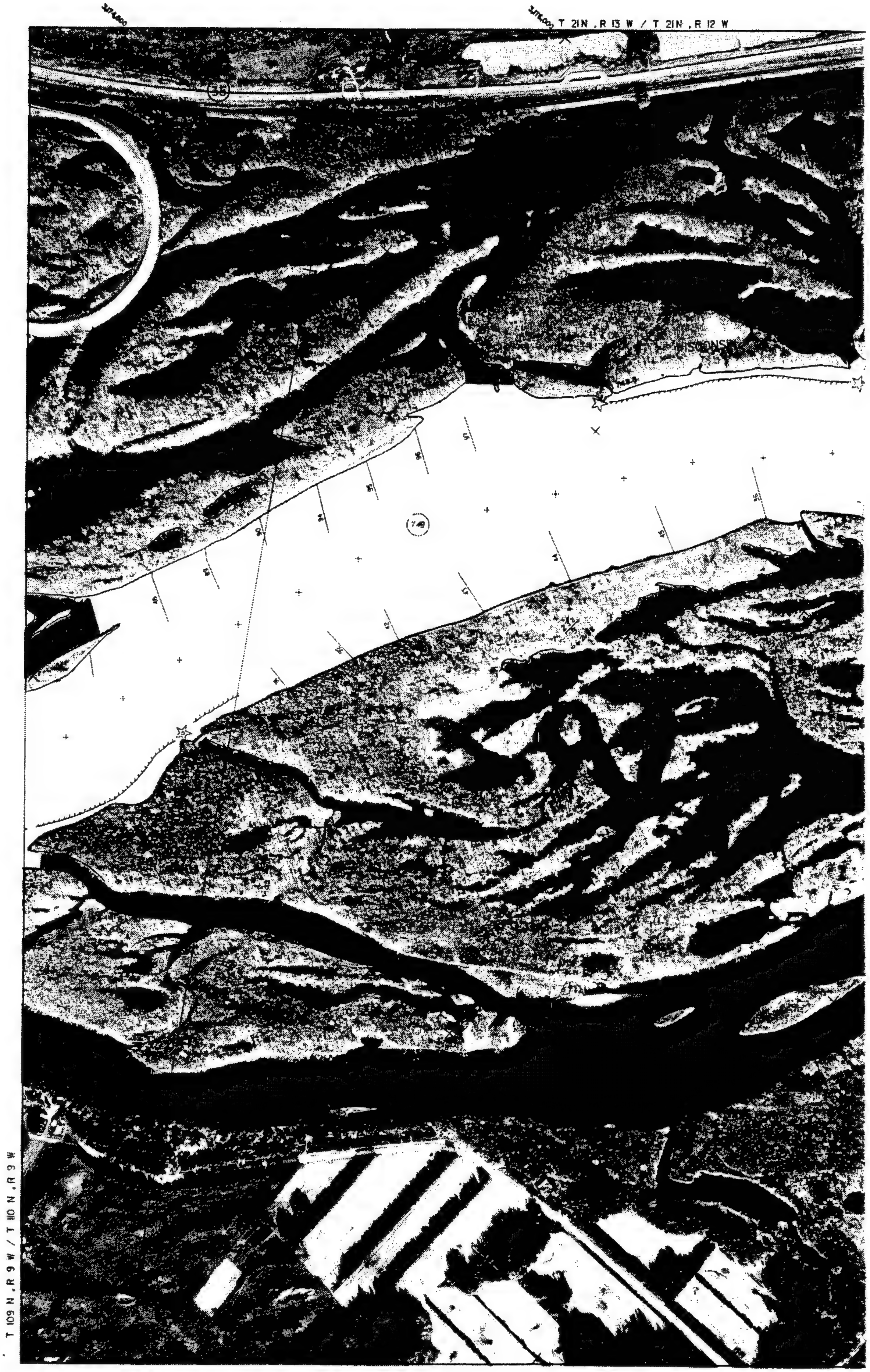
Channel Maintenance Coordinator	____	____
Chief, Waterways Section	____	____
Project Manager	____	____

Remarks: ________

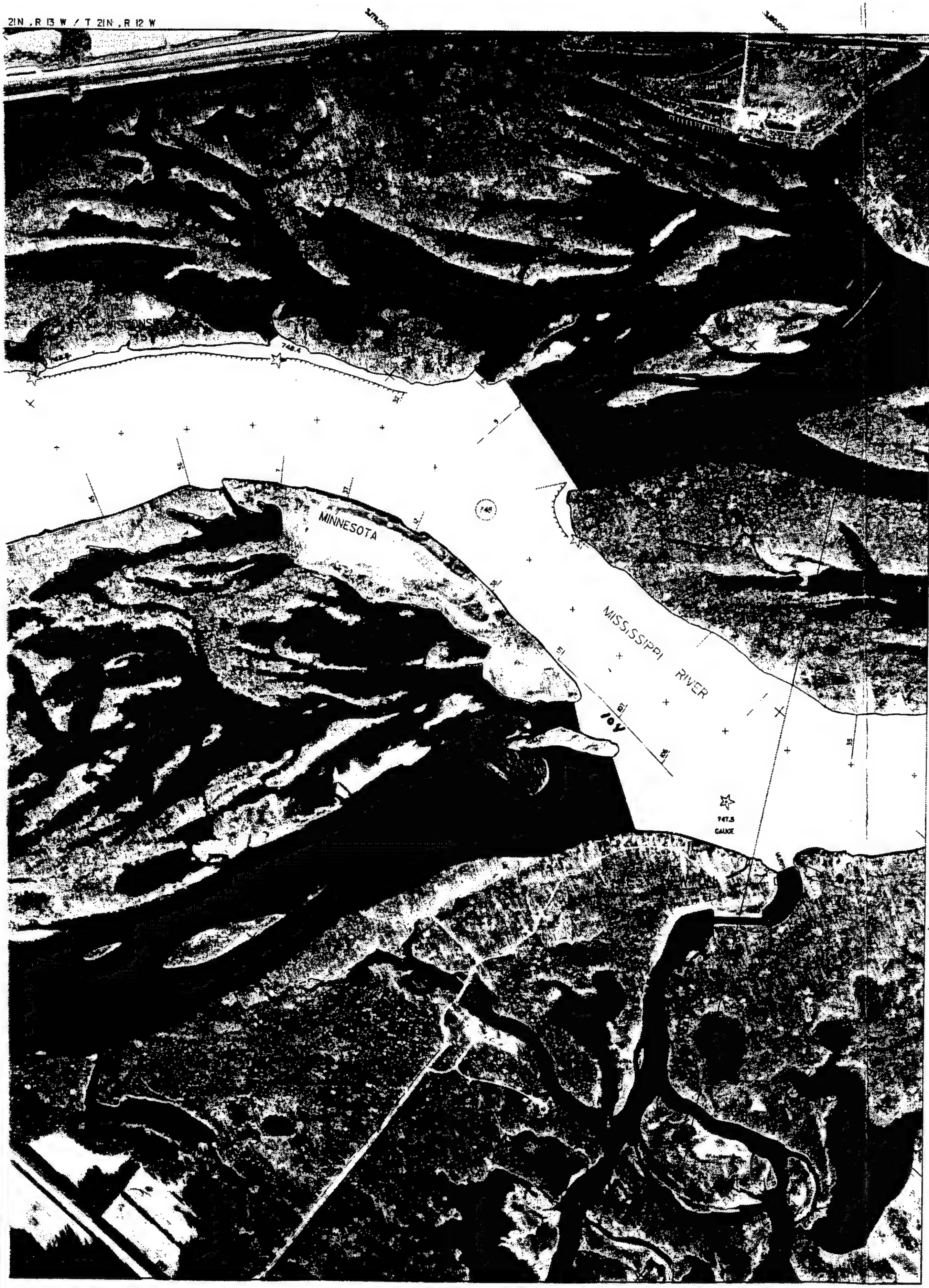
MILE 751.0 LCP 660.0
MILE 749.0 LCP 660.0

UPPER MISSISSIPPI RIVER IMPROVEMENT ST. PAUL DISTRICT		
UPPER ZUMBRO		
MILE 749.5 TO 751.3	SCALE 1"=400'	SHEET 5-07

Plate 5b



MARKHURD



HUB	AZIMUTH

Survayed By:
Gage Reading.
Indivic
Processor
Unit Chief
Channel Maintenan

____ 1. No Actioi
____ 2. Resurve
____ 3. Dredge A

Channel Maintenanc
Chief, Waterways Se
Project Manager

Remarks:

UPPE

MILE 747.

HUB	AZIMUTH	DISTANCE	COORDINATES		ELEVATION
			NORTH	EAST	

NOTE

CONTROL SURVEYS FURNISHED BY ENVIROSCIENCE, INC.

THIS MAP MEETS NATIONAL MAP ACCURACY STANDARDS

COORDINATES BASED ON MINNESOTA STATE PLANE GRID SYSTEM, SOUTH ZONE, N.A. DATUM OF 1983.

DATE OF PHOTOGRAPHY: NOV., 1992

Surveyed By:________ **Launch**________ **Acres** ____

Gage Reading______ **Location:**______ **UMR**

Individual	Initials	Date
Processor		
Unit Chief		
Channel Maintenance Coordinator		

____ 1. No Action
____ 2. Resurvey ________
____ 3. Dredge Area As Shown

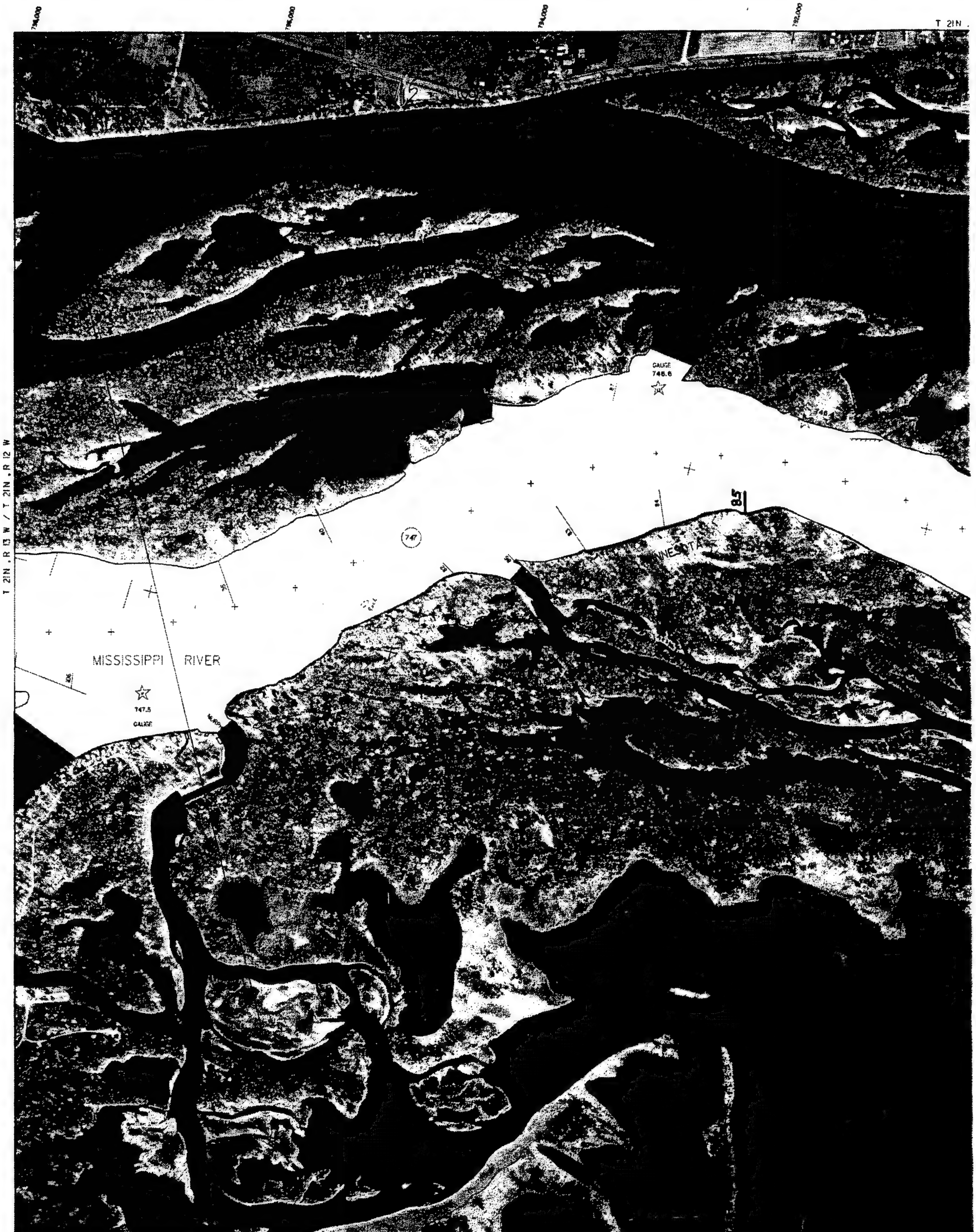
Channel Maintenance Coordinator		
Chief, Waterways Section		
Project Manager		

Remarks:________

MILE 749.0 LCP 660.0
MILE 748.0 LCP 660.0

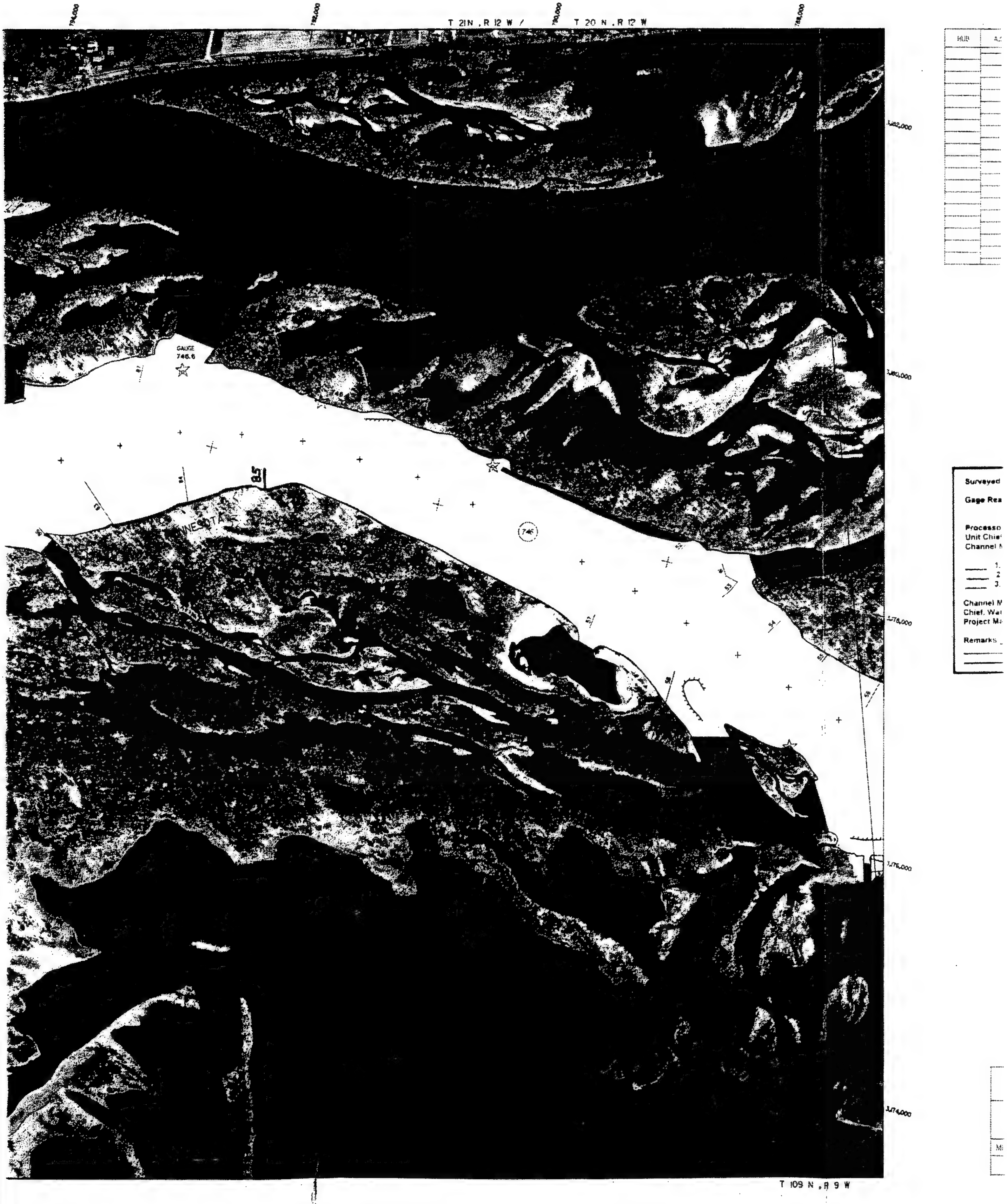
UPPER MISSISSIPPI RIVER IMPROVEMENT ST. PAUL DISTRICT		
MULE BEND		
MILE 747.5 TO 749.7	SCALE 1"=400'	SHEET 5-06

Plate 5c

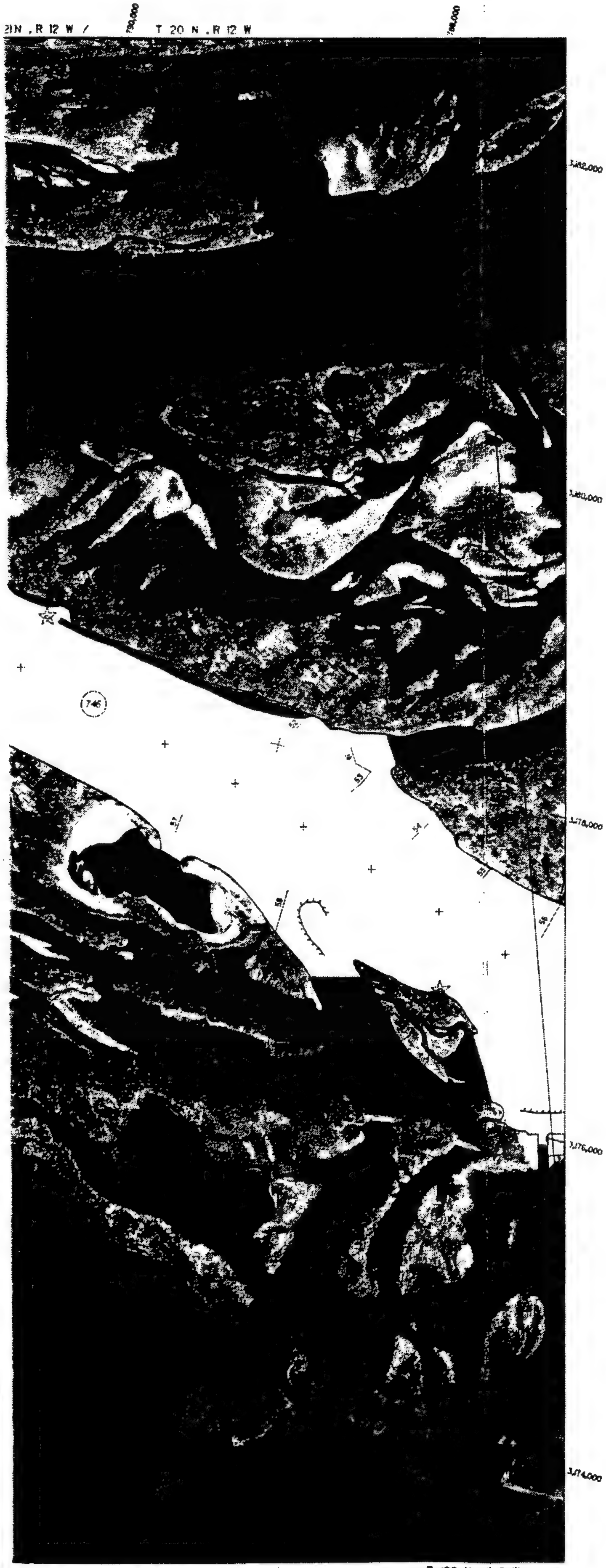


796,000
794,000
792,000
T 21N .
T 21N . R 13 W / T 21N . R 12 W
GAUGE
748.6
85
747
MISSISSIPPI RIVER
747.5
GAUGE

MARKHURD



T 21N , R 12 W /
T 20 N , R 12 W
GAUGE
746.6
T 109 N , R 9 W
Surveyed
Gage Rea
Processo
Unit Chie
Channel M
Channel M
Chief, Wa
Project Ma
Remarks



HUB	AZIMUTH	DISTANCE	COORDINATES		ELEVATION
			NORTH	EAST	

NOTE

CONTROL SURVEYS FURNISHED BY ENVIROSCIENCE, INC.

THIS MAP MEETS NATIONAL MAP ACCURACY STANDARDS

COORDINATES BASED ON MINNESOTA STATE PLANE GRID SYSTEM, SOUTH ZONE, N.A. DATUM OF 1983.

DATE OF PHOTOGRAPHY: NOV., 1992

Surveyed By: ________ **Launch** ________ **Acres** ____

Gage Reading ______ **Location:** ______ **UMR**

Individual	Initials	Date
Processor	____	____
Unit Chief	____	____
Channel Maintenance Coordinator	____	____

____ 1. No Action
____ 2. Resurvey ________________
____ 3. Dredge Area As Shown

Channel Maintenance Coordinator	____	____
Chief, Waterways Section	____	____
Project Manager	____	____

Remarks ____________________

MILE 747.0 LCP 659.9
MILE 746.0 LCP 659.9

UPPER MISSISSIPPI RIVER IMPROVEMENT ST. PAUL DISTRICT		
FISHER ISLAND		
MILE 745.5 TO 747.2	SCALE 1"=400'	SHEET 5-05

Plate 5d

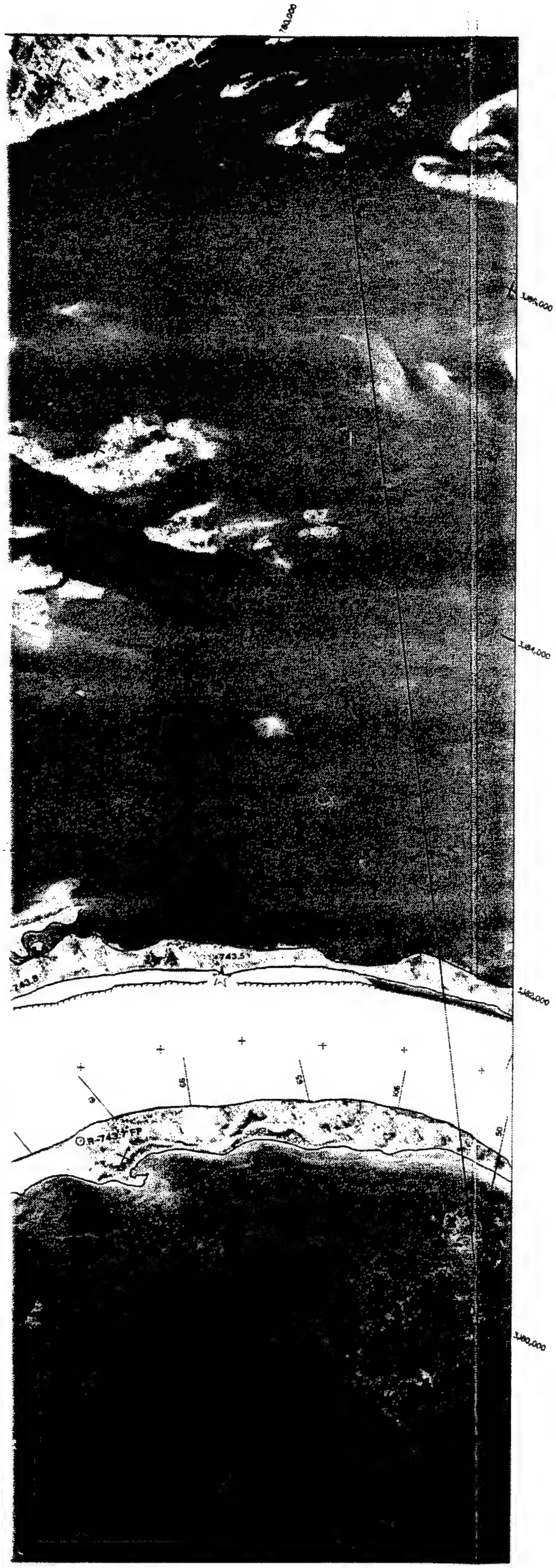
3

T 20 N, R 13 W / T 20 N, R 12 W

Plate 5f

Plate 5f

2



T 109 N , R 9 W

HUB	AZIMUTH	DISTANCE	COORDINATES NORTH	COORDINATES EAST	ELEVATION
R-743.7	F.P.		778,289.95	3,179,913.09	
R-743.9	F.P.		779,420.28	3,179,203.59	
R-744.3	F.P.		780,994.42	3,177,932.90	
L-743.5		S-18	779,141.11	3,180,481.37	
L-744.2		S-19	780,182.11	3,179,488.52	
L-744.5		S-20	781,525.02	3,178,755.54	

NOTE

CONTROL SURVEYS FURNISHED BY ENVIROSCIENCE, INC.

THIS MAP MEETS NATIONAL MAP ACCURACY STANDARDS

COORDINATES BASED ON MINNESOTA STATE PLANE GRID SYSTEM, SOUTH ZONE, N.A. DATUM OF 1927.

DATE OF PHOTOGRAPHY: NOV. [illegible]

Surveyed By: ________ Launch __________ Acres ____

Gage Reading ______ Location: ________ UMR

Individual	Initials	Date
Processor		
Unit Chief		
Channel Maintenance Coordinator		

____ 1. No Action
____ 2. Resurvey ______________
____ 3. Dredge Area As Shown

Channel Maintenance Coordinator		
Chief, Waterways Section		
Project Manager		

Remarks: ______________________

MILE 745.0 LCP 659.8
MILE 744.0 LCP 659.8

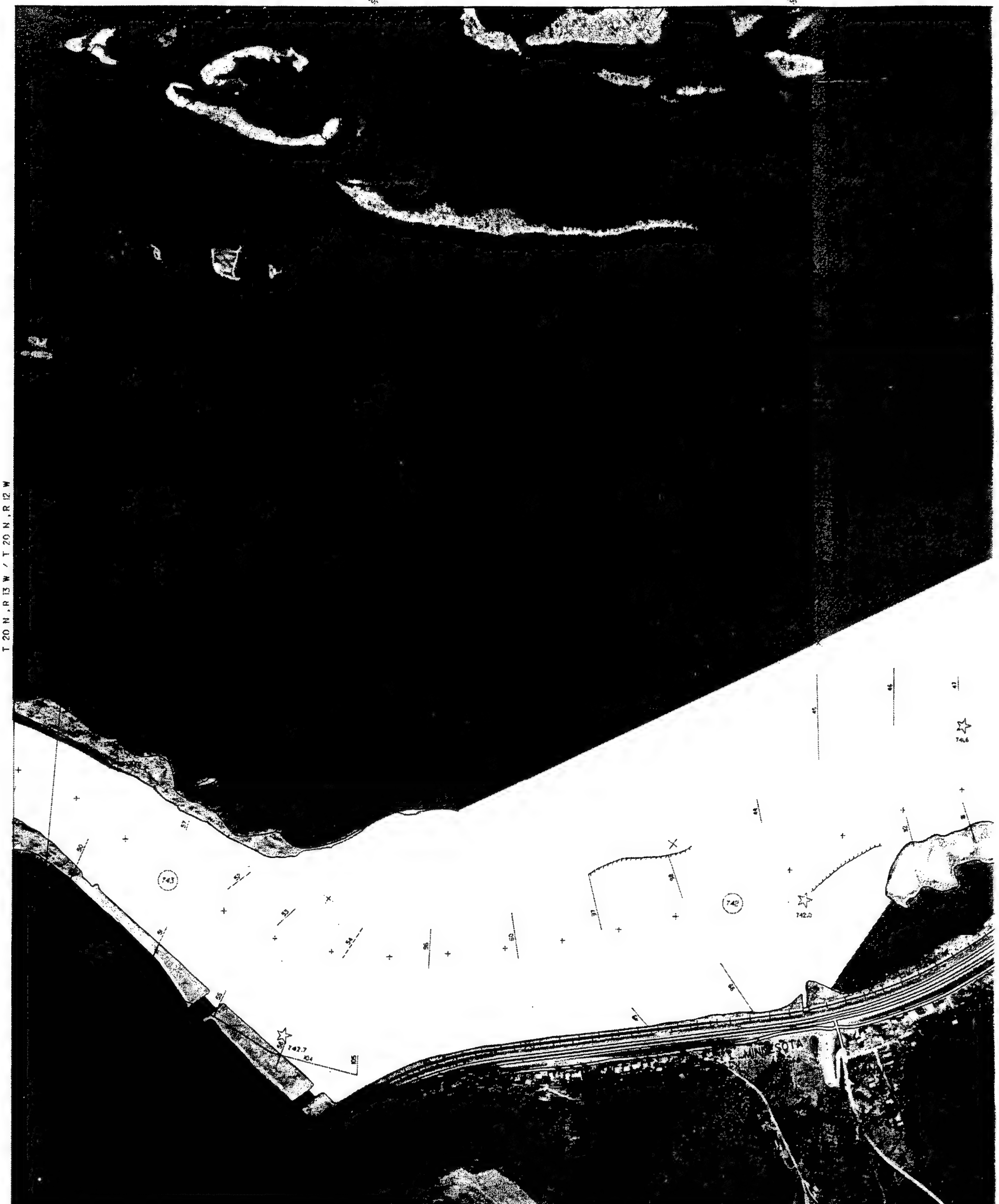
UPPER MISSISSIPPI RIVER IMPROVEMENT
ST. PAUL DISTRICT

LOWER ZUMBRO - SOMERFIELD ISLAND

MILE 743.5 TO 745.3 | SCALE 1"=400' | SHEET 5-04

Plate 5e

T 20 N, R 13 W / T 20 N, R 12 W



T 109 N, R 9 W / T 108 N, R 9 W

HUB	AZIMUTH	DISTANCE	COORDINATES NORTH	COORDINATES EAST	ELEVATION

NOTE

CONTROL SURVEYS FURNISHED BY ENVIROSCIENCE, INC.

THIS MAP MEETS NATIONAL MAP ACCURACY STANDARDS

COORDINATES BASED ON MINNESOTA STATE PLANE GRID SYSTEM, SOUTH ZONE, N.A. DATUM OF 1983.

DATE OF PHOTOGRAPHY: NOV., [illegible]

Surveyed By:________	Launch:________	Acres ____
Gage Reading:________	Location:________	UMR
Individual	**Initials**	**Date**
Processor	____	____
Unit Chief	____	____
Channel Maintenance Coordinator	____	____

____ 1. No Action
____ 2. Resurvey ____________
____ 3. Dredge Area As Shown

Channel Maintenance Coordinator	____	____
Chief, Waterways Section	____	____
Project Manager	____	____

Remarks:____________________

MILE 743.0 LCP 659.7
MILE 742.0 LCP 659.7
MILE 741.0 LCP 659.6

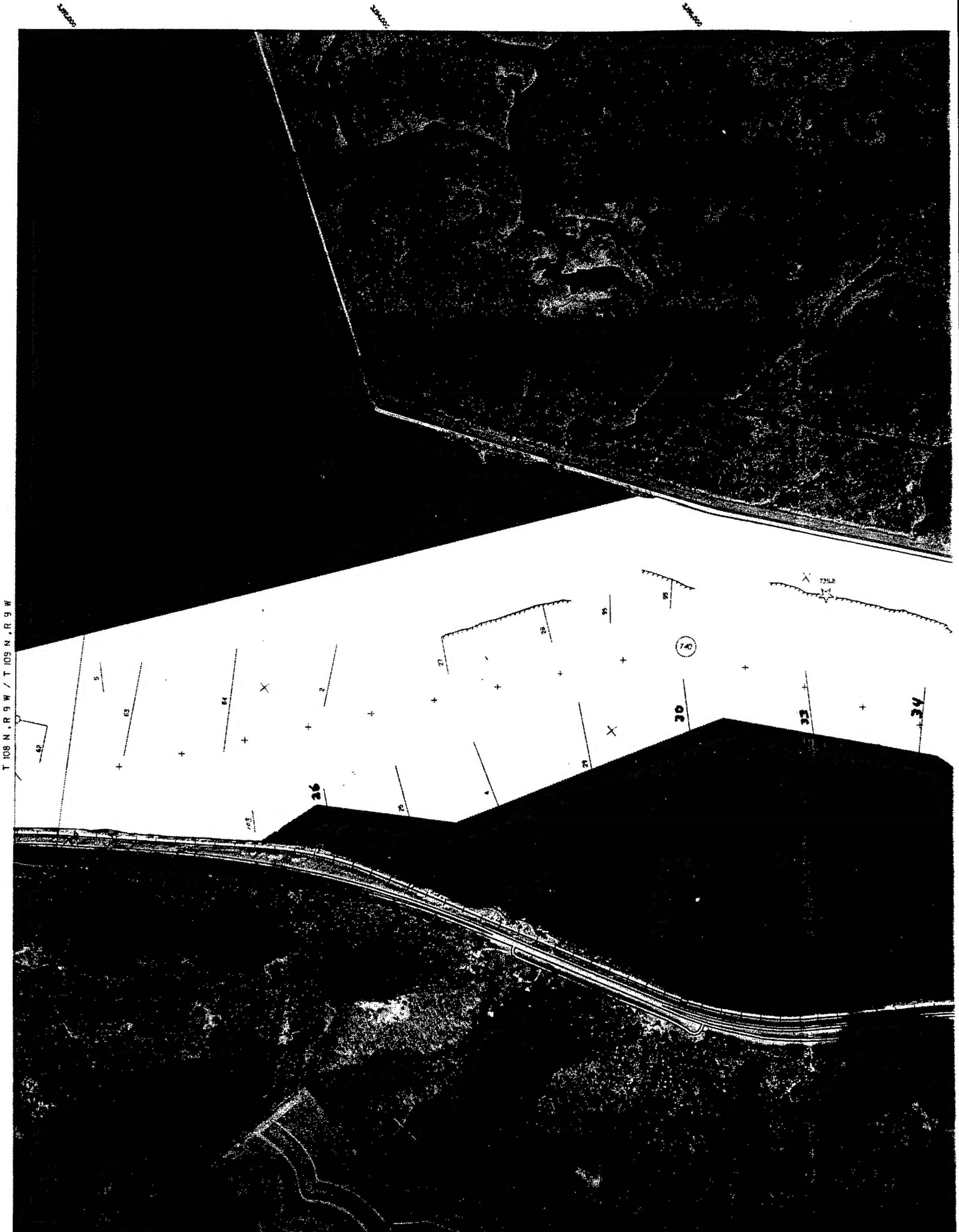
UPPER MISSISSIPPI RIVER IMPROVEMENT
ST. PAUL DISTRICT

MINNEISKA

MILE 741.0 TO 743.3	SCALE 1"=400'	SHEET 5-03

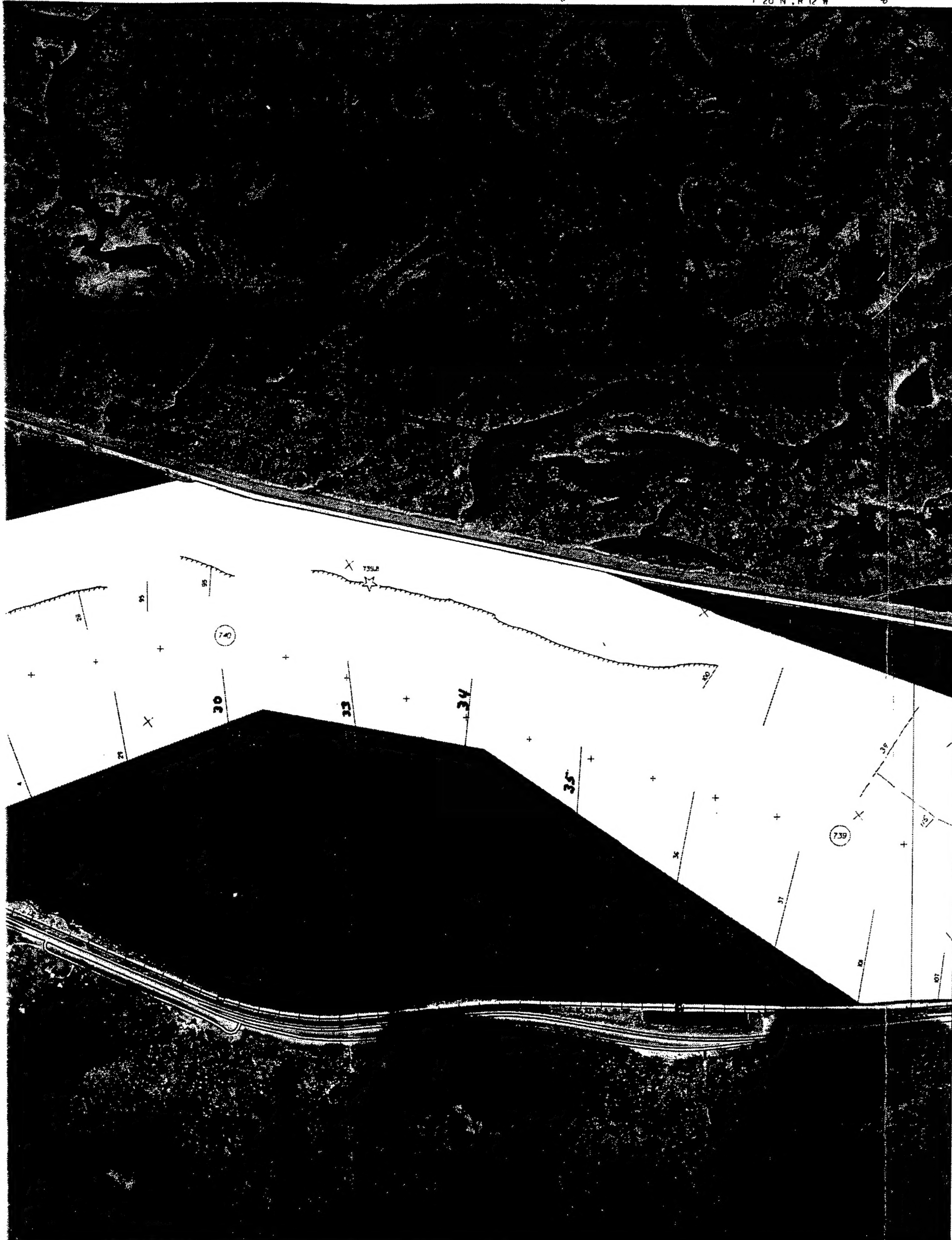
Plate 5f

2



MARKHURD

T 20 N , R 12 W



T 108 N , R 9 W / T 108 N , R 8 W

HUB	

Surveye

Gage R

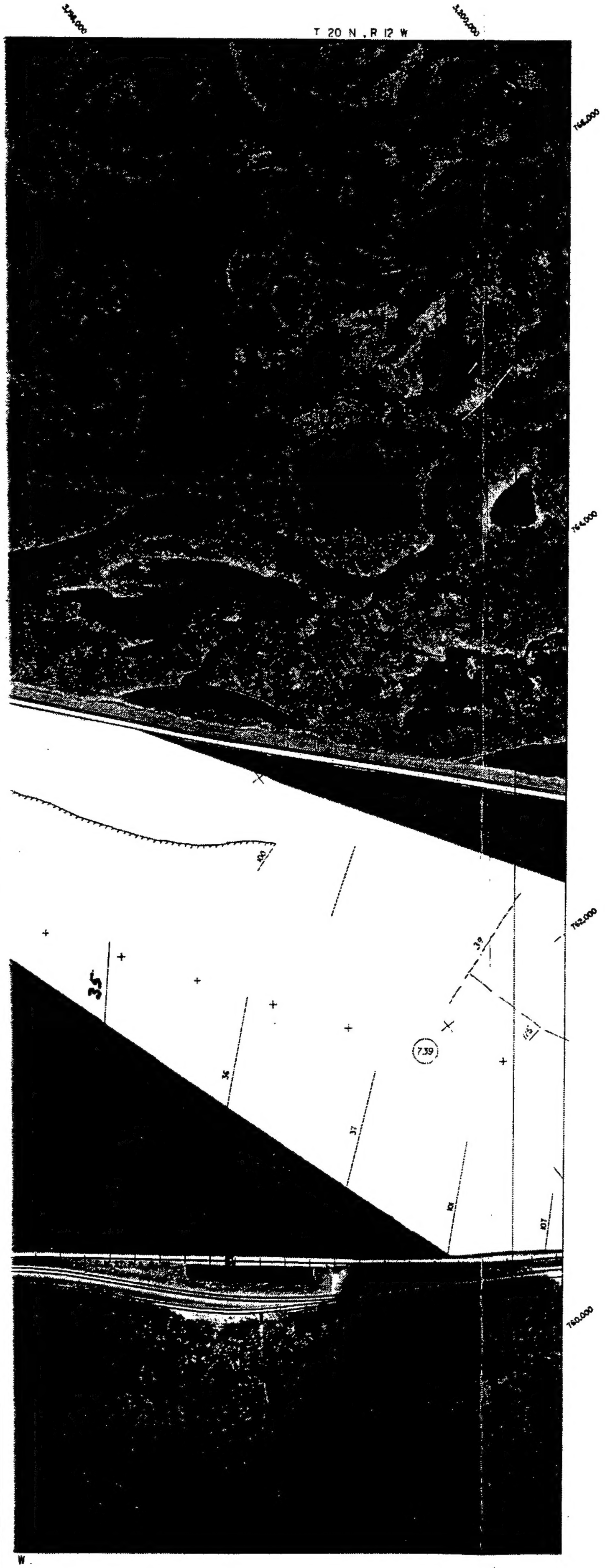
Process
Unit Ch
Channe

Channel
Chief, W
Project M

Remarks

MI

1



HUB	AZIMUTH	DISTANCE	COORDINATES		ELEVATION
			NORTH	EAST	

NOTE

CONTROL SURVEYS FURNISHED BY [illegible], INC.

THIS MAP MEETS NATIONAL MAP ACCURACY STANDARDS

COORDINATES BASED ON MINNESOTA STATE PLANE GRID SYSTEM, SOUTH ZONE, N.A. DATUM OF 1983.

DATE OF PHOTOGRAPHY: NOV., [illegible]

Surveyed By:________ Launch__________ Acres ____

Gage Reading:_______ Location:________ UMR

Individual	Initials	Date
Processor	____	____
Unit Chief	____	____
Channel Maintenance Coordinator	____	____

____ 1. No Action

____ 2. Resurvey ______________________

____ 3. Dredge Area As Shown

Channel Maintenance Coordinator	____	____
Chief, Waterways Section	____	____
Project Manager	____	____

Remarks: ______________________________

MILE 741.0 LCP 659.6
MILE 740.0 LCP 659.6
MILE 739.0 LCP 659.5

UPPER MISSISSIPPI RIVER IMPROVEMENT
ST. PAUL DISTRICT

MT. VERNON RICHMOND LT.

MILE 738.8 TO 741.0 | SCALE 1"=400' | SHEET 5-02

Plate 5g